SAFETY ELEMENT
OF THE GENERAL PLAN

City of San Luis Obispo

ADOPTED AUGUST 1, 1978
BY CITY COUNCIL RESOLUTION 3622

116-86

PREFACE

On June 5, 1975, the San Luis Obispo County and Cities Area Planning Coordinating Council (now the San Luis Obispo County Area Council of Governments) authorized Envicom Corporation to proceed with studies for a Regional Safety Element in accordance with a joint powers agreement among the County of San Luis Obispo and the cities of Arroyo Grande, Grover City, Morro Bay, Paso Robles, Pismo Beach and San Luis Obispo. The result was a two-part document summarizing the work performed by Envicom Corporation and the Area Planning Council's member jurisdictions.

This document, the City of San Luis Obispo Safety Element, was derived in large part from the Regional Safety Element. It includes the Technical Report (Part II) from the regional study. The first part of the city Safety Element, the Policy Report, reflects Envicom's work as it pertains to the city, and as revised by the staff of the city's Community Development Department and the City Council. This final documentation of studies has been prepared in accordance with California Government Code Section 65302.1.

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(*Available from the city's Community Development Department)

INTRODUCTION

What's this about?

Earthquakes, landslides, fires, floods, radioactive spills -- these things happen or could happen in San Luis Obispo. They can mean injury, death, destruction and economic chaos for a few or many. Although we can't prevent them, we can do a lot to reduce the damage they do. If we plan for them.

That's what this document is: the city's plan to reduce the threat from these natural and man-caused disasters and to be as ready as possible to respond when they do occur. This plan includes technical studies of the dangers involved, studies that seek to define and locate the threat as precisely as possible. It also includes policies designed to make San Luis Obispo a safer place to live. It does this by helping the city avoid dangerous situations where possible, prepare for the unavoidable, and assure that such vital facilities as hospitals are in good enough shape after a disaster to treat the injured and keep the community operating.

By accounting for hazards in planning the use of land, in regulating construction and in making other policy decisions, the city can save lives and property. That's why this safety plan is part of the city's general plan. It's one of several "elements" that make up the total general plan.

This City of San Luis Obispo Safety Element is concerned with several specific potential hazards: wildland fire, urban fire, natural flooding, dam-related flooding, geologic hazards and radiation. (Geologic hazards are treated generally in this element, since they are dealt with in detail in the city's Seismic Safety Element.)

This element also is concerned with the capabilities of the various emergency-response agencies serving the city. These agencies must be ready to act, and act effectively.

Two aspects of public safety are outside the scope of this document: crime and accidents. However, this Safety Element relates indirectly to those two concerns because it deals with emergency preparedness. Policies that improve the response of police and firefighters to major disasters should help improve their response to crime and accidents also.

The element deals mainly, of course, with San Luis Obispo's urban area. But disasters don't acknowledge city limit lines, so the city and this element also must deal with hazards in the surrounding area. For the purposes of studying and regulating the use of land, the geographical extent of the city's concern is what's called the city's "planning area." This is roughly the area of the San Luis Creek watershed north of Davenport Creek, extending several miles from the city into Cuesta Canyon, and into the Chorro, Los Osos and Edna valleys. But some potential threats to the city come from sources even outside the planning area -- such as from the Diablo Canyon nuclear power plant. And some city facilities, such as Whale Rock Reservoir, are some distance from the city. This element also deals with those.

It's required.

The city is required by state law to consider geologic, fire and other hazards in its planning program. As part of the recent, growing interest in planning, the California Legislature made local governments responsible for identifying and evaluating these hazards and for reducing the risks they create. Specific authority for a safety element is derived from Government Code Section 65302.1 which requires the following:

> "A safety element for the protection of the community from fires and geologic hazards including features necessary for such protection as evacuation routes, peak load water supply requirements, minimum road widths, clearances around structures and geologic hazard mapping in areas of known geologic hazard."

The premise behind this requirement is that if government is to ensure public safety and welfare, it must recognize the dangers posed by fire, flooding, earthquake and other hazards and must plan accordingly. The rationale for preparing a safety element is that it will be easier to take public action to make a city safer if precise information about hazards is available and if there is an official framework for taking appropriate action.

What should be done with this document?

This document is intended to serve as an official guide for the city's council members, planning commissioners and staff members, as well as for citizens and private organizations concerned with public safety in San Luis Obispo. It is intended to give city government a uniform policy and direction in working to minimize risk to life and property.

The heart of the element is in its goals, policies and recommendations for action. These guidelines should be used in conjunction with other policies contained in the city's general plan and should play a major role in determining the future use of land. After the Safety Element is adopted, it should be updated regularly.

The element is in two parts. The first part, the Policy Report, deals with ways to reduce risk in the city. The second part, the Technical Report, analyzes the risks created by potential hazards in the city and county and estimates the magnitude of the events that should be anticipated.

Part I's policies rely on Part II's technical estimates of how big, how frequent and where the hazards will be. These estimates are derived from sciences, such as seismology and fire ecology, which are relatively young, and in which much remains to be learned. The city believes we should incorporate what we know today into the planning process and not wait until we know all we would like to know.

POLICY REPORT

PART I: POLICY REPORT

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I. EXISTING CONDITIONS

A. Types of Hazards

Four basic groups of hazards are considered in this Safety Element: fire, flooding, geologic and radiation hazards.

Fires in undeveloped areas involving accumulated brush and other vegetation, termed "wildland fires," are a significant threat to San Luis Obispo. Wildland fires are treated separately from "urban fires," which occur in built-up areas and involve primarily structures. Automobile fires and small-to-medium-sized brush fires within urban areas are included in the urban fire category. These two categories of fire hazard are the types considered in this document.

Flood hazards in and near the city are also considered in two categories: natural flooding and dam inundation. "Natural flooding" means the inundation of developed areas that occurs when a storm causes streams or storm drains to overflow. Dam inundation is the downstream flooding that would occur if a dam broke or overflowed.

The discussion of seismic (earthquake) and geologic hazards in the Safety Element consists primarily of a synopsis of the detailed discussion contained in the Seismic Safety Element. That discussion groups earthquake hazards in a cause-and-effect classification which is the basis for the order of their consideration. Earthquakes originate as shock waves generated by movement along an active fault. The primary seismic hazards are ground shaking and the potential for ground rupture along the surface trace of the fault. Secondary seismic hazards result from the interaction of ground shaking with existing soil and bedrock conditions, and include liquefaction, settlement, landslides, tsunamis or "tidal waves," and seiches (oscillating waves in lakes or reservoirs).

The potentially damaging events discussed above can, of course, damage man-made structures. The potential for structural failure is termed a structural hazard. This includes not only damage to structures themselves, but also damage or injury from moving objects in, on or next to a structure. Of particular concern in the Safety Element is the effect of seismic activity on important public utilities such as gas, electric and water lines. The relationship between seismic hazards and dam safety is also considered in this element.

An analysis of radiation hazards is not specifically required by the Government Code, but is included in the San Luis Obispo Safety Element because of Pacific Gas and Electric Company's nuclear power plant at Diablo Canyon. Unlike the analyses of fire, flooding and geologic hazards, the evaluation of radiation hazards does not include an estimate of risk. The potential for a hazardous situation arises from the presence and transport of highly radioactive nuclear fuel. This hazard is recognized by utilities, government agencies and private citizens, and numerous steps have been taken to minimize the risk of a release of high levels of radiation. Yet some level of risk, however small, does exist. It is appropriate to plan for an accident. The emphasis of this element with respect to radiation hazards is on emergency-response capabilities rather than on risk.

More in-depth discussions of radiation and the terminology of fire, flooding and geologic hazards are presented in the Technical Report.

B. Summary of Technical Conclusions

The foundation of the Safety Element is its technical evaluation of fire, flooding and geologic hazards. The analyses of radiation hazards and emergency-response capability also

form part of the basis of the policies contained in this report. Major conclusions from the different technical analyses, updated to reflect developments since the Technical Report was completed, are as follows:

1. Fire Hazards

a. The city is confronted with one of the more hazardous wildland fire situations in the county because of its location near the foothills of the Santa Lucia Mountains and the Irish Hills. There is great danger from fire in the foothills northeast and southwest of the city and on Cerro San Luis Obispo, Bishop Peak, Chumash Peak and Islay Hill.

b. The city faces complex urban fire hazards ranging from industrial fires to the hazards of older and high-occupancy dwellings in the downtown area and near the Cal Poly campus.

c. Specific urban fire hazards in the city include the following: (1) insufficient fire flows in numerous areas throughout the city, (2) potential response delays caused by traffic congestion, (3) potential response delays caused by topography and man-made features such as the railroad and Highway 101, (4) hazards associated with community infrastructure systems such as gas and electric lines, (5) inadequate service to the southern end of the South Higuera Street area. (It takes a fire engine more than four-minutes -- the recommended response time -- to get to the end of South Higuera.)

d. A fire station being built at the corner of Madonna Road and Los Osos Valley Road is expected to be completed by April 1978. This station will provide adequate fire protection for the Laguna area, which has been outside the four-minute response zone. Engines from this station also could reach the residential and industrial areas along South Higuera Street in less than four minutes if a bridge were built over San Luis Creek to link Los Osos Valley Road with South Higuera.

2. Flood Hazards

a. The potential for natural flooding in the city exists along the length of San Luis Creek and along its major tributaries: Stenner Creek, Brizziolari Creek and Prefumo Creek. Areas which might be particularly hard hit are along San Luis Creek -- downtown and between Higuera/South Higuera Street and the freeway.

b. Lakeside residential areas in the Laguna neighborhood have in the past been subject to flooding. But in 1974 a larger culvert was built under Madonna Road at the southeast end of Laguna Lake. This culvert was designed to drain the lake fast enough to prevent future flooding of lakeshore areas.

c. The Broad Street-Lincoln Street area near the point where Stenner and Old Garden creeks meet has been subject to flooding in the past. A new culvert under Highway 101, nearing completion, is designed to handle 100-year flows, and should help to relieve the problem in this area and upstream.

3. Geologic Hazards

The geologic hazards analysis contained in the Technical Report is, for the most part, a synopsis of the detailed analyses presented in the 1975 San Luis Obispo Seismic Safety Element. In addition to the summary of primary and secondary seismic hazards, the Safety Element's technical analysis provides a brief discussion of the effects of seismic hazards on utilities and of the relationship between geologic hazards and dam safety. Summary conclusions of these structural hazards are presented below. Those wishing to review the seismic hazard summary are referred to the Safety Element Technical Report, pp. 54-60. The following conclusions are generalized, and are not based on investigations of specific structures within the city. Such investigations are, of course, necessary before specific conclusions regarding the safety of any individual structure can be made.

a. Public Utilities. On the basis of experience gained from the San Fernando earthquake of 1971, the following general conclusions may be drawn regarding the behavior of public utility structures during a major earthquake. Any comparison of the damage at San Fernando and expected damage in San Luis Obispo should be taken in the context that most of the significant damage in the San Fernando area was along or near the zone of fault rupture or in areas of very intense ground shaking with some liquefaction. General conclusions are as follows:

"1. Modern steel water-storage tanks and old water-reservoir roof structures performed poorly. Old hydraulic earth-fill dams, not designed to resist earthquake loads, performed poorly, with two experiencing near-failure.

2. Underground conduits for water, sewage, storm water, gas and petroleum were damaged, mainly because of permanent differential ground movements rather than due to vibration. Effective preventive measures in this field will be difficult to develop. Potential ground-movement areas should be identified.

3. Large underground structures such as the Finished Water Reservoir at the Joseph Jensen Filtration Plant require special attention. Apparently, they act much like structures above grade. More research is needed, along with development of design criteria.

4. Electrical power equipment performed poorly. Failures were due to inadequate anchorage and bracing and, in some cases, to inadequate aseismic details within the equipment.

5. Communication equipment in the telephone industry performed well except for several failures due to inadequate or poorly detailed and constructed anchorages and bracing." (Moran and Duke, 1975).

b. Dam Safety

(1) Studies for the County Seismic Safety Element indicate surface rupture along an active fault through a dam structure itself is not a significant hazard to any major dam of concern to the city.

(2) The ability of major dams in the area to withstand expected ground shaking in the event of a large-magnitude earthquake has not been determined. A city-funded seismic study of the federally-owned Salinas Dam at Santa Margarita Reservoir -- from which the city gets most of its water -- is under way. Older structures are of more concern than more recent, compacted-fill or concrete-arch structures.

(3) Overtopping of impounded water as a result of massive landsliding into a full or nearly full reservoir is a significant potential hazard at the city's Whale Rock Reservoir at Cayucos and at the privately owned Righetti Reservoir southeast of the city.

4. Radiation Hazards

Since the technical analysis of radiation hazards contained in Part II of this document is a general background statement on radiation and nuclear power plants, no major conclusions specific to San Luis Obispo are provided. It is assumed that an accidental release of harmful levels of radiation is possible, despite the fact that such an accident is unlikely. Planning for such an accident is prudent and necessary for public safety.

5. Emergency Preparedness

a. The county's peacetime emergency organizations rely heavily on the concept of mutual aid for responding to major disasters. While the basic planning framework and emergency

inventories should be adequate for most disasters, they may prove insufficient when confronted with a major earthquake, widespread flooding or a large fire.

b. Mutual aid in the city and county provides economical emergency services, but is less than optimally efficient, particularly for the fire-fighting organizations.

c. Emergency communications between different agencies cooperating under mutual aid agreements may be impaired in a major disaster by the lack of a common emergency-communication channel.

C. Risk

Given that certain natural hazards exist in San Luis Obispo, it is necessary to decide whether the risks these hazards present are acceptable or whether action is necessary to reduce the level of risk. The California Council on Intergovernmental Relations defines "risk" from natural and man-made hazards in three categories:

1. Acceptable risk: The level of risk below which no specific action by government is deemed to be necessary.

2. Unacceptable risk: The level of risk above which specific action by government is deemed to be necessary to protect life and property.

3. Avoidable risk: A risk which need not be taken because individual or public goals can be achieved at the same, or less, total "cost" by other means without taking the risk.

To determine levels of acceptable risk is to provide an answer to the question "How safe is safe enough?" No environment is perfectly hazard-free. Natural and man-made hazards of some kind are always present, especially in urban environments. However, some hazards cause only minimal loss or occur so rarely that they need not be planned for at the community level. On the other hand, some events occur often enough, are large enough, and have enough potential for major disruption of the community to warrant a community-wide response to the risk. Deciding the level of response to natural hazards such as fire and flooding is a public process which involves making a judgment, either explicit or implicit, about acceptable risk. Scientific expertise can determine the magnitude of the hazard and estimate the probable effects, but it cannot decide for the public how much risk to assume.

The central concept used in determining levels of acceptable risk is the definition of natural events in terms of magnitude and frequency. The magnitude of an event refers to its size. Examples are the height of flood waters, the rating of an earthquake on the Richter scale, or the number of acres burned in a wildland fire. The frequency of an event refers to the number of times it occurs during a certain period of time. The relationship between magnitude and frequency is inverse. That is, the less often an event occurs, the greater is its size and potential impact. For example, rainstorms occur annually in San Luis Obispo County, but most often they are of low magnitude and do not seriously threaten residents. However, on infrequent occasions, as in January and February 1969, a storm of large magnitude passes over the region and results in a dangerous flood. A way of summarizing this idea with respect to an earthquake is that the longer it waits, the bigger it will be.*

* There is one important difference between flooding and earthquakes, however. Flooding is the result of a random combination of meteorological events, whereas current geologic theory indicates that the buildup of strain along a particular fault system is nearly constant, and the periodic release of that strain in the form of an earthquake is apt to be regular.

The magnitude-frequency concept is involved in the decisions regarding acceptable risk in that the community must judge what magnitude of event should be planned for. That judgment is based on the frequency or recurrence interval of the hazardous event. A description of the magnitude and other characteristics of the event are developed through a technical analysis. This information allows planners and engineers to develop ways to reduce losses and to design structures to provide protection up to the level of acceptable risk. In this sense, the magnitude of earthquake or flood used in defining acceptable risk may be thought of as a "design earthquake" or "design flood."

The determination of acceptable risk from hazardous events also involves differentiating among man-made structures according to their potential effect on the loss of life and their importance in terms of emergency response and continued community functioning. In the hours immediately following the 1971 San Fernando earthquake in Southern California, emergency services were impaired by damage to police and fire stations, communication networks and utility lines. A number of major hospitals in the area were seriously damaged and were unable to continue functioning at the time they were needed most. These facilities and others are vital to the community's ability to respond to a major disaster and to minimize loss of life and property. The experience in San Fernando emphasizes the need to provide these "critical facilities" a higher level of protection from natural hazards than is provided for noncritical structures. The city's Seismic Safety Element contains a recommended list of critical facilities based on potential effects on loss of life and importance to continued community functioning. This list, slightly revised, is reproduced here as Table 1.

By considering both the natural event and the type of land use or facility, a framework for making risk decisions can be established. Table 2 provides a summary of risk criteria used to formulate the policies stated in the next section.

TABLE 1

CLASSIFICATION OF CRITICAL FACILITIES

Land Use/Facility	Safety Characteristic		
	Potential Effect on Loss of Life	Emergency Response	Required for Community Functioning
Developed Land			
PUBLIC AND SEMI-PUBLIC USES			
- Hospitals	X	X	X
- Schools/colleges	X		
- Civil defense quarters		X	X
- Fire & police stations		X	X
- Government offices		X	X
- Fossil-fuel power plants		X	X
- Nuclear power plants	X	X	X
- Gas & electric lines and stations		X	X
- Dams	X	X	X
- Radio/TV/microwave centers & lines		X	X
- Aqueducts & pipelines		X	X
- Sewage treatment facilities		X	X
- Gas stations		X	X
- Electrical substations		X	X
- Waterworks		X	X
- Radio & TV stations		X	X
- Major roads and highway bridges		X	X
- Railroads			X
- Airports			X
- Auditoriums & other places of public assembly	X		

TABLE 2

SUMMARY OF RISK CRITERIA

Hazard [1]	Risk Criteria
Wildland Fire	Risk categories: Extreme, High, Moderate, Low Nil
Urban Fire	Generalized categories not recommended; building-by-building evaluations necessary.
Natural Flooding	100-year floodplain.
Dam Inundation	Office of Emergency Services; Dam inundation maps.
Seismic/ Geologic Hazards	See Seismic Safety Element.

[1] Risk evaluations for radiation hazards are beyond the scope of this element.

II. RELATIONSHIP TO OTHER GENERAL PLAN ELEMENTS

A. General

The technical data compiled in the preparation of the Safety Element and presented in Part II should be used by persons engaged in the planning process. While the data are generalized in some respects and require further detailed studies, the findings of the element should be reflected in other general plan elements and in controls placed on developments within the city's planning area.

The Safety Element is most closely related to the Seismic Safety, Land Use, Circulation and Open Space elements. An extensively revised Land Use Element was adopted by the city in January 1977. The city's Seismic Safety Element, adopted in September 1975, is relatively up-to-date and only minor revisions are expected. The Circulation Element, adopted in 1972, needs major revisions. The Open Space Element, adopted in 1973-74, also requires extensive revision. Key points of this Safety Element were considered in revising the Land Use Element and will be considered when other elements are revised.

B. Seismic Safety Element

In terms of legislative intent, the Seismic Safety and Safety elements are probably the most similar of the state-mandated general plan elements. The Seismic Safety Element introduces earthquake hazards into the planning process, and the Safety Element extends the introduction to include fire, flooding and other geologic hazards. The Safety Element also includes a discussion of emergency preparedness as related to all types of peacetime safety hazards, including seismic hazards.

The similarity between these two elements is reflected by the inclusion of a summary of the Seismic Safety Element in the Safety Element Technical Report and by the safety policies presented in this part of the Safety Element. These elements can best be used by planners as a single unit which defines the natural hazards (and some man-caused hazards) confronting the city. There is some overlap in the recommended policies of these elements. It is advisable to review these elements together to determine applicable policies on mitigating hazards.

C. Land Use Element

The Urban Land Use Element will be influenced most directly by the recommendations of Policy 3.0 (pages 1.10 and 1.12) to regulate land use in areas of significant natural hazard. Although the city has the potential for considerable growth, this growth could be located to minimize danger from natural hazards. The objective is to use the information contained in this element to reduce the risk to life, to reduce the probability of property loss, and to ensure that critical public facilities can continue to function during and after a major disaster. Table 3 presents a summary of land-use policies for different hazard areas. This table may also be used to evaluate the effect of "stacking," or the combination of several hazard zones on a single parcel of land, which results in a high level of overall risk. As noted in the preceding section, these policies should be reviewed in conjunction with those contained in the Seismic Safety Element.

TABLE 3

LAND-USE POLICY SUMMARY

LAND USE/FACILITY	FIRE AND FLOODING HAZARDS						
	[1]E	H	M	L	Nil	[2]100F	[3]DI
Critical							
(e.g., Hospitals, fire stations, police stations, and others as shown on Table 1)	Ⓧ	Ⓧ	⊘	○	○	Ⓧ	Ⓧ
Noncritical							
(e.g., Low-density residential, multifamily residences, light industry, parks and recreation areas, agriculture)	Ⓧ	Ⓧ	⊘	○	○	⊘	⊘

Explanation

○ Generally suitable for development
⊘ May be suitable for development with site study and hazard mitigation.
Ⓧ Generally unsuitable for development.

[1] Fire hazard zones. [2] 100-year flood area.

[3] Areas of potential dam inundation.

Notes: This table is for general planning purposes only. Suitability for specific uses and sites must be confirmed by further investigations. If an area is evaluated as generally unsuitable for a particular use, that does not necessarily preclude the use if all potential hazards can be mitigated.

The most important implication of safety-oriented land-use planning is that those buildings and activities which are essential to the continued functioning of the city in the aftermath of a major natural disaster be located in the safest places. Other critical facilities should be located only in those areas where design can ensure that they will not become a major threat to life in the event of a flood or fire.

These land-use policies, however, are not intended to provide a rigid definition of acceptable and unacceptable uses for each hazard zone. The suitability of a specific use for a specific site should be evaluated in the light of current scientific information. If an area is evaluated as generally unsuitable for a particular use, that does not necessarily preclude the use if all hazards can be mitigated in a manner acceptable to the city. However, if such risks cannot be adequately reduced, prohibiting the use is the only alternative.

D. Circulation Element

The basic circulation networks in the city and county are well established, and are recognized in the Regional Transportation Plan and the city's and county's circulation elements.

The primary implication of the Safety Element for the city's Circulation Element is that a major flood can be expected to block transportation routes within the city and to other cities. This is expected to have an important impact on potential evacuation and emergency-response efforts.

The Circulation Element is also related to the Safety Element with respect to fire hazards. Wildland fires are often ignited at the roadside by burning objects tossed from passing vehicles or by accidents. Fire hazards should be considered when future routes are selected.

E. Open Space Element

The Safety Element provides important information for the Open Space Element by defining certain naturally hazardous areas. Together with the earthquake hazard areas identified in the Seismic Safety Element, the fire and flood hazards identified in the Safety Element suggest areas for open-space uses. Specifically, these areas include land within the 100-year floodplain, areas potentially threatened by dam inundation, and areas of extreme or high fire danger.

III. GOALS, POLICIES AND RECOMMENDED ACTION

A. Organization of Planning Recommendations

The previous section of this Policy Report established the general framework within which planning for public safety should take place. It presented a summary of the existing dangers to the city and a summary of how various degrees of risk can be used as criteria in deciding how to deal with hazards.

This section of the Policy Report is the heart of the city's Safety Element. It establishes goals and policies and recommends specific actions that should make the city safer. (The specific planning actions are termed "implementation measures.")

The goals help us keep sight of the reasons for safety planning. The policies point the directions the city should take to meet the goals. The implementation measures are the actions that will carry out the policies.

While it would be desirable to fully implement all of the policies, the city recognizes that money and manpower are limited. In determining priorities for allocating the community's resources, the city will consider the expense required to implement the various policies, the ease with which each could be acted upon, and how important each policy is in achieving the Safety Element's goals.

B. Goals

The city's goals in dealing with dangerous natural and man-caused events are:

1. To minimize injury and loss of life.
2. To minimize damage to public and private property.
3. To minimize social and economic dislocations resulting from injury, death and property damage.

C. Policies

The following general policies complement the planning goals and define specific directions for the city to take in reducing risk:

1.0 Identify and evaluate existing structural hazards in buildings used by the public and abate those hazards to acceptable levels of risk.

2.0 Ensure that new development within the city's planning area is designed to withstand the effects of natural and man-caused hazards to acceptable levels of risk, and is designed to aid emergency response.

3.0 Control the use of land in areas of significant potential hazards.

4.0 Maintain and improve emergency-response planning and organization.

5.0 Provide for more detailed scientific analysis of natural and man-caused hazards.

6.0 Educate the public in the nature and extent of hazards in the area and in ways of minimizing the effects of disasters.

7.0 Review and improve the Safety Element on a regular basis.

D. Implementation Measures

1.0 Identify and evaluate existing structural hazards in buildings used by the public and abate those hazards to acceptable levels of risk

1.1 Within the city, buildings which are used by the public should be inspected by qualified structural engineers, fire officials and flood control officials for susceptibility to damage from fire, flooding and geologic hazards. Inspections should be conducted according to the following order of priority:

1. Emergency-service facilities (e.g. fire and police stations, hospitals).
2. Other critical facilities (e.g. schools, government buildings).
3. High-occupancy buildings (e.g. theaters, restaurants).
4. Other noncritical facilities (e.g. offices, stores, high-density apartments).

Safety inspections should not be required for single-family homes.

1.2 Caltrans should review its facilities and roadways within the city's planning area to determine the potential impact of expected earthquakes and floods, and should forward comments to the city. Potential evacuation routes and the Circulation Element of the general plan should be revised if necessary.

1.3 The Southern Pacific Transportation Company should review its lines and yards within the study area to determine the potential impact of the expected earthquakes, and should forward comments to the city. The Circulation Element of the general plan should be revised if necessary.

1.4 The Pacific Gas and Electric Company should review its facilities and distribution/transformation networks and centers to determine the potential impact of expected earthquakes, and should forward comments to the city. PG&E should also review its gas and power lines for potential fire hazards.

1.5 The city should encourage the inspection of Righetti Reservoir by qualified structural engineers to determine its ability to withstand the ground-shaking criteria presented in the Seismic Safety Element.

1.6 If a structure has been identified as not conforming to earthquake standards or as a fire or flood hazard, the risks it creates should be brought down to acceptable levels. This might be done by altering or rebuilding the structure or by other means. Where flooding is the threat, risk could be reduced by improving drainage rather than altering structures.

1.7 The city should begin condemnation proceedings in cases where structures are earthquake or fire hazards.

(a) To implement this policy the Planning Commission shall recommend to the City Council criteria for determining what constitutes a significant fire or seismic hazard. These criteria should take into account the historic quality of many of the city's older buildings.

(b) Appropriate city departments should begin condemnation proceedings in individual cases.

1.8 The city should advocate the expansion of state and federal relocation-assistance funds and programs to aid persons and businesses displaced from hazardous buildings.

2.0 Ensure that new development within the city's planning area is designed to withstand the effects of natural and man-caused hazards to acceptable levels of risk, and is designed to aid emergency response

2.1 With the Seismic Safety Element and Safety Element as guidelines, the city's building regulations should be reviewed and revised, if necessary, to incorporate new minimum safety requirements regarding seismic resistance, floodproofing and fireproofing, and to address police and fire department safety concerns.

2.2 All new construction in the city should, as a minimum, meet the most recent safety requirements in the Building Code.

2.3 The city should review design standards set by the zoning and subdivision regulations to make sure they address the safety concerns of the police and fire departments. Prevention (including crime prevention) and response should be among the considerations addressed.

2.4 All new public facilities intended to reduce risk from natural or man-caused hazards (e.g. flood control projects, firebreaks) should use the planning and technical criteria presented in the Safety Element as basic guidelines.

3.0 Control the use of land in areas of significant potential hazards

3.1 New critical facilities (see Table 1) should be generally excluded from the 100-year flood plain and from areas of potential dam inundation. Noncritical facilities should be allowed to locate in potential flood areas only if the facilities are elevated or floodproofed to the level of the 100-year flood and do not obstruct the free flow of storm waters.

3.2 Development should be generally excluded from areas of extreme and high wildland fire danger. Development should not be permitted in areas of moderate fire danger without an examination of its vulnerability to fire and its potential for starting one. Wood-frame and other combustible structures and untreated wood-shake roofs should be prohibited in areas of extreme and high danger and carefully evaluated in moderate-danger areas.

3.3 The use of off-road vehicles during periods of high fire danger should be controlled. Rigid inspection standards for off-road vehicles -- muffler and spark-arrester controls at minimum -- should be established.

3.4 Land-use controls to reduce risk from seismic and geologic hazards are described in the city's Seismic Safety Element. In summary, these measures include the following:

(a) Prohibit construction in areas of high landslide risk unless the slope stability of the specific site is investigated.

(b) Prohibit critical facilities in areas of very high liquefaction potential; regulate noncritical facilities in these areas, usually requiring site-specific analysis of liquefaction potential.

4.0 Maintain and improve emergency-response planning and organization

4.1 The city has prepared, and is responsible for maintaining, an emergency plan as required by the California Emergency Services Act. Among the peacetime emergencies considered in the plan are earthquakes, fires, and floods. The Seismic Safety and Safety elements provide estimates of the magnitude and location of these events and, therefore, provide important information for the emergency plan. The city's emergency-service agencies should review their responsibilities and capabilities in light of the information contained in the two safety elements. Particular attention should be given to the city's reliance on mutual aid and the adequacy of communications between different emergency agencies in the county.

4.2 The city Fire Department should work with county and state agencies to improve mutual-aid arrangements to achieve adequate fire protection in rural areas around San Luis Obispo.

4.3 The city should review its emergency plan to anticipate emergency services which may be required under mutual-aid agreements in the event of a radiological accident at the Diablo Canyon Nuclear Power Generating Station. The city's emergency plan should also be revised to anticipate a radiological accident during the transportation of radioactive waste from the Diablo Canyon plant. Primary emphasis should be given to responding to an accident on the Southern Pacific rail line or on U.S. 101.

5.0 Provide for more detailed scientific analysis of natural and man-caused hazards

5.1 The potential for landslide-generated water waves in Righetti Reservoir and their possible effects on the surrounding area should be evaluated in detail.

5.2 For future water impoundments, an evaluation of potential inundation areas should be required and dams should be designed to withstand the earthquakes which can be expected in the area.

5.3 After a significant number of site-specific soil studies have been made in areas believed to have very high potential for liquefaction, the city should retain a qualified geologist to determine whether the potential for liquefaction does in fact exist.

6.0 Educate the public in the nature and extent of hazards in the area and in ways of minimizing the effects of disasters

6.1 The city should develop a program to familiarize residents with the Safety Element. Special attention should be given to those groups particularly susceptible to seismic, fire and flood hazards, including, but not limited to, school districts, agencies involved with the aged, and agencies involved with handicapped persons. These agencies should be encouraged to develop their own education programs. The conclusions and recommendations of these elements should also be provided to land developers and those involved in the real estate profession.

6.2 Programs should be established to train volunteers to assist police, fire and civil defense personnel during and after a major earthquake, fire or flood.

6.3 Education programs should be initiated in lower grades, using displays and demonstrations that would expose younger children to the nature and strength of fire. Such programs should tend to replace their natural curiosity with a sense of respect.

6.4 The city should support or sponsor exhibits and presentations in secondary schools which demonstrate the more involved aspects of fire, such as major factors contributing to fire hazard and the relationship of fire to the natural ecology. The city

also should encourage parents to help in the overall fire-education program.

6.5 The city should enforce its ordinance requiring smoke detectors in all residences.

7.0 Review and improve the Safety Element on a regular basis

7.1 After the Safety Element is adopted, the Community Development Department should see that the city acts on the element's recommendations. The department should keep the City Council posted on progress.

7.2 The Safety Element should be revised comprehensively every five years or whenever substantially new scientific evidence becomes available.

TECHNICAL REPORT

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I. INTRODUCTION

This Technical Report for the City of San Luis Obispo Safety Element is the Technical Report from the Regional Safety Element prepared in 1975 for the San Luis Obispo County and Cities Area Planning Coordinating Council, with the exception that pp. 2.20 and 2.21 concerning fire hazards in the City of San Luis Obispo were updated in April 1978.

The purpose of this part of the Safety Element is to provide the necessary technical back-up for the recommendations contained in the Policy Report. To that end, this part analyzes a series of major potential hazards to life and property. Since it was part of the Regional Safety Elelent, it analyzes hazards throughout the county. Primary emphasis of the report is on analysis of wildland and urban fire hazards, natural flooding and dam inundation. The report also presents a discussion of potential radiation hazards and emergency preparedness within the county.

The technical nature of some of the information contained in this report necessitates a scientific dicussion. However, because of the diverse audience for the Safety Element, the approach has been to minimize the use of detailed discussions whenever possible and to rely on qualitative descriptions of methodology and safety hazards. Those wishing a more detailed discussion of public safety hazards are referred to the works listed in the References section.

II. FIRE HAZARDS ANALYSIS

A. General Statement

The major emphasis in this portion of the investigation is the analysis and evaluation of fire hazards originating in both the developed and undeveloped areas in the County of San Luis Obispo. Fires occurring in developed areas are most often structural fires, automobile fires, and small to medium-sized brush fires. Fires in undeveloped areas include large brush and forest fires that commonly engulf tracts of land several hundred to many thousands of acres in size.

The Fire Hazards portion of the study is organized to reflect the inherent differences between urban fire and non-urban fire. Section B1 will discuss the various aspects of fire in the undeveloped portion of the County, including the factors which create fire hazards, and Section B2 will focus upon the causes of urban fires. Section C examines the level of fire hazards and response capability in both developed and undeveloped areas of the County.

Losses through fire have climbed at a steady pace since World War II, reflecting the increase in dollar values through inflation and economic growth. The cost in terms of human life has also increased such that over 12,000 deaths and 2,000,000 non-fatal burns occur each year throughout the nation. These continued losses, which are occurring despite rapidly improving fire-fighting techniques, demonstrate the need for more efficient fire prevention. Land use planning as a means of reducing fire hazards is one means through which more effective prevention can be attained.

B. Contributing Factors to Fire Hazard

1. Wildland Fire Hazards

a. General

Fires in undeveloped areas that result from the ignition of accumulated brush and woody material are termed "wildland fires, and represent a major threat to safety throughout the State. In recent years, large wildland fires have plagued much of California, destroying structures and exacting a heavy toll on life and valuable watershed acreages. During a 13-day period in 1970, wildfires throughout the state destroyed over 580,000 acres of wildland, consumed 722 homes, and damaged thousands of other structures. Sixteen lives were lost and property damage soared to 233 million dollars.

The basic wildland fire problem confronting California is that wildland fire is a natural element of the regional environment. Therefore, despite the State's having the best financed and most effective wildland fire protection organization in the world, the problem persists. The three environmental factors most responsible are climate, vegetative cover, and topography. Another factor which has exacerbated the problem is man's presence in fire prone areas, a condition that is increasing as more and more human activity is introduced through residential development and recreational activities.

b. Natural Factors

(1) Climate

California's climate is Mediterranean with cool moist winters followed by long, dry summers. Rainfall decreases

sharply with a drop in elevation from the mountains to the lower foothills and valleys. The long summers with little or no precipitation are often accompanied by relatively high temperatures and low humidity away from the immediate coastline. The long rain-free periods, warm air temperatures, and high humidity draw moisture out of large accumulations of dead fuel and place living vegetation under increased moisture stress.

The position of San Luis Obispo County relative to the Pacific Ocean and the Coast Range helps to modify climatic extremes, producing a diversity of climatic regimes throughout the County. At its widest point (measured diagonally), the County is over 120 miles long. Along that line, climatic conditions vary from the cool, damp north coast to the hot and dry Cuyama Valley. Cool winds from the Pacific and frequent fogs help maintain moisture levels in the local vegetation along the coast to retard fire. However, the climatic conditions of the Santa Lucia Mountains and the inland plains and valleys create very dry conditions, conducive to wildland fire.

(2) Vegetative Fuel Potential

The second natural factor contributing to the overall hazard of fire is the type of vegetative cover. Vegetation is closely related to the type of climate of an area. Many species of plants respond to available moisture as the most limiting environmental factor. In areas where moisture is more or less in constant supply through rainfall, stream runoff or persistent fogs, dense evergreen forests become established. However, in drier areas where rainfall is more restricted and fogs are only a minor environmental element, vegetative types adaptable to low moisture conditions develop and flourish. Among these dry-adapted species are the common chaparral and interior grassland elements including chamise (Adenostoma fasciculatum), various Ceanothus species, and grasses of many varieties.

The type of vegetation present, along with its density and distribution, can define both the overall hazard of fire in a particular area and the intensity of fire which ensues. These characteristics of the local vegetation can also determine the fire's spreading potential, and can decide the recurrence intervals to be anticipated between outbreaks of fire. San Luis Obispo County contains 14 naturally-occurring plant communities, a reflection of the County's diverse environmental profile. The following table lists the various communities, as well as their fire hazard potential.

Table 1
Wildland Fire Hazard Fuel Potential

Extreme	High	Medium	Low	Nil
Chaparral	North Coastal Scrub	Riparian Woodland	Beach-dune	Coastal Salt Marsh
	Foothill Woodland	North Coastal Grassland	Coastal Sand-plains	Freshwater Marsh
	Juniper Oak Woodland	Evergreen Forest	Saline Plains	
		Interior Herbaceous		
		Desert Scrub		

Chaparral is a general term that describes a great variety of closely-crowded evergreen shrubs. Stands of chaparral can differ widely in species from place-to-place, however, chamise (Adenostoma fasciculatum) is its most constant member.

Ceanothus cuneatus is probably second in abundance, with other species of Ceanothus being more abundant in certain localities (Hoover, 1970). Species of manzanita (Arctostaphylos) are also common members of the chaparral community in San Luis Obispo County as are several scrub species of oak (Quercus dumosa, Q. durata, Q. Wislizenii var. frutescens, etc.). Chaparral is most commonly found on the drier, sun-exposed slopes of hills, mostly inland, extending to La Panza Range.

Chaparral, especially chamise-dominated stands, are the most fire hazardous plant community encountered in the area. Chamise contains a large percentage of volatile oils within its tissues that can ignite and burn with a great deal of vigor. A name once applied to chamise was "grease wood", a term that aptly characterizes fires in overgrown chamise areas. Chaparral communities have not only adapted to a dry environment, but have come to virtually depend on fire as a necessary element in the environment. Several component species of the chaparral community require the scorching heat of fire for seedling germination, while others have developed the capacity to re-sprout from existing root stocks. This capability allows a burned community to rapidly re-establish itself such that in the span of four to five years, re-vegetation will be approximately 70% complete.

Three communities, North Coastal Scrub, Foothill Woodland, and the Juniper Oak Woodland, compose a "high" fire risk potential. North Coastal Scrub is best represented from Cambria northward, and is characterized by the presence of species of Ceanothus, Mulefat (Baccharis pilularis) manzanita (Arctosyaphylos spp.) and California Sage (Artemisia californica). As the term "scrub" implies, this community is fairly low, and shrublike in nature. It presents a high degree of flammability due to the volatility of the plant tissues, however, the lack of overall density, and the absence of chamise makes it a lesser threat than chaparral.

Foothill Woodland can be found from the east base of the Santa Lucia Range across the upper Salinas Valley to the hills bordering La Panza Range on both sides. Foothill Woodland can also be found in the upper Arroyo Grande Valley as well as Cuyama Canyon (Hoover, 1970). It is dominated by species of drought resistant trees including Digger Pine (Pinus Sabiniana), Blue Oak (Quercus Douglassii), Valley Oak (Quercus lobata), and Live Oak (Quercus agrifolia). Foothill woodlands often exist together with certain chaparral elements that further compound the fire problems that exist. The overall moisture stress in the dry environment of the Foohill Woodland also contributes to the hazard potential.

Juniper-Oak Woodland characterizes the vegetation around the north end of La Panza Range, southward along the San Juan River, and in the higher regions of the Temblor Range. The high fire hazard of California Juniper (Juniperus californica) - Blue Oak (Quercus Douglassii) plant community results from its adaptation to dry conditions as well as the understory growths of grasses and shrubs that could readily burn if ignited.

The five plant communities whose presence generally indicates a medium fire hazard include: Riparian Woodland, Evergreen Forest, Interior Herbaceous, and Desert Scrub. One of two characteristics apply to each of these communities, and explain their medium fire hazard status. Each community listed either (1) maintains a sufficiently high moisture content to partially mitigate fire hazard buildup, or (2) possesses such an open and/or sparse density profile, that the chances of a wildland fire igniting and consuming widespread acreages are less likely.

Riparian woodlands are usually composed of broad-leaved trees that thrive under the moist conditions found in and along creek bottoms. Representative species include California Sycamore (Platanus racemosa), Cottonwood (Populus Fremontii), and Bigleaf Maple (Acer macrophyla). The high moisture content of the leaves and woody tissues along with the usually permanent supply of water helps mitigate the hazard of fire in this plant community.

The Northcoastal Grassland Plant Community can be found in scattered locations throughout the County, however, it is best represented on the open hills and ocean bluffs from Cambria northward. In many portions of its range, the community has been disturbed through grazing and other farming activities. The hazard potential of the Northcoastal Grassland community is decreased due to the cool and moist climatic regimes of areas in which it is found.

The Evergeen Forest community, much like the Riparian Woodland, is found in areas where moisture is more plentiful. Greater rainfall amounts, and persistent fogs help maintain the amount of water, and create the necessary conditions for the various species of the community. These species include several pine species, Live Oak (Quercus agrifolia), Canyon Oak (Quercus chrysolepis), California Laurel (Umbellularia californica) and Madrone (Arbutus menziesii). Evergreen Forest usually occurs in rather small areas near the coast and in the Santa Lucia Range (Hoover, 1970).

"Interior Herbaceous" is a plant community extensively found in the eastern portion of the County. It is comprised of many herbaceous and grassy species that have flourished in rangeland areas, disturbed by livestock grazing. Areas of Interior Herbaceous vary significantly from one another, because of soil differences and local climates (Hoover, 1970). However, the grazing activities of livestock as well as the low growing herbaceous nature of the vegetation renders such areas a medium fire hazard instead of a "high hazard" as encountered in North Coastal Grassland areas.

The Desert Scrub plant community is best represented in the Temblor Range, especially southward to the South slope of Caliente Mountain (Hoover, 1970). Its representative species include Desert Tea (Ephedra california), Saltbush (Atriplex polycarpa), and Buckwheat (Eriogonum fasciculatum var. polifolium). The Desert Scrub community is generally a community quite open and sparse, a factor which mitigates the community's fire potential despite its dry character.

The five remaining plant communities in the San Luis Obispo County area comprise the "low" and "nil" wildland fire hazard fuel potential categories identified in Table "Low" hazard categories include the following:

(1) The Beach-Dune community found from Pismo Beach to the mouth of the Santa Maria River, and along the west side of Morro Bay.

(2) Coastal Sand-plains and stabilized dunes, located inland from the Beach-Dune Community, including the South side of Morro Bay and the Nipomo Mesa (Hoover, 1970).

(3) Salina Plains, located in the Cholome Valley; Carrizo Plain around Soda Lake; south to Cuyama Valley.

Each of these three communities includes a fairly sparse, low-growing flora, the structure of which minimizes their overall fuel potential.

The "nil" categories include vegetative categories directly linked to the presence of standing water, and they include

the Coastal Salt Marsh and Freshwater Marsh communities. The aquatic nature of these plant communities preclue the potentiality of wildland fire.

(3) Topography

The third major natural factor influencing wildland fire hazards is the topography of the area. Topography has considerable effect on wildland fire behavior and the ability of fire fighters and their equipment to take suppressive action on those fires.

San Luis Obispo County lies astride the Santa Lucia Mountains, a major portion of the Coastal Range of California. The Santa Lucias rise to altitudes greater than 3500 feet and form a mostly continuous tract of rugged terrain with numerous canyons and ridges of slopes approaching 100%. The presence of the Santa Lucia's in the western portion of the County has contributed significantly to the levels of wildland fire hazards.

The rough topography of the Santa Lucias greatly limits road construction and road standards, and accessibility by ground equipment. The California Division of Forestry has classified slopes relative to fire prevention on the following basis:

	% Slope
Class I	0-40
Class II	41-60
Class III	61+

Slope Class I fires can be attacked with all-wheel-drive equipment, bulldozers, hand crews, and aircraft. Slope Class II fires are beyond the operating capability of all-wheel-drive equipment, but can be attacked using bulldozers, handcrews and aircraft. Slope Class III fires can be effectively combatted only through the use of handcrews and aircraft.

Using the Division of Forestry criteria, most slopes in the Santa Lucia Mountains are Class III. Class I and II slopes occur to the east of the range. The Irish Hills, an isolated mountainous area south of Morro Bay also contains slopes of Class I and Class II stature.

Steep topography can also have a major effect on the behavior of fire. Canyons and ridgelines tend to channel air flows, creating extremely erratic winds on lee slopes in an area. Fires also demonstrate a tendency to rapidly spread in an upslope direction, due to the super heating which occurs above a fire within the confines of a canyon.

c. Human Factors

The principal human factor important in the analysis of wildland fire is the presence of people in the wildlands. Recent statistics compiled by the State Division of Forestry indicate that over two-thirds (2/3) of all wildland fires are caused by human activities in one form or another. The following list describes the types of man-caused fires and their relative percentage of occurrence:

Power line facilities	23%
Incendiary or arson	22%
Machine use	16%
Debris burning	6.1%
Total	67.1%

Source: California Division of Forestry, 1972

Despite the type and amount of fuel present, topography, or weather conditions, a wildland fire requires an ignition source, and according to available records people furnish that source 67.1% of the time. For that reason, wildland areas exposed to human activites, either through urbanization, back country recreation,

power line easements, or circulation via back country roads, might warrant a more severe fire hazard classification.

2. Urban Fire Hazards

a. General

Fire has long been recognized as an especially dangerous threat in urban areas. As the population concentrates in increasingly built-up areas, the factors necessary for fire ignition increase as do the chances of a fire spreading rapidly once it starts. These same factors of population, material, and energy concentrations in cities mean that loss of life, injury, and property damage from fire are greater in urban areas. The historic great fires in Chicago and San Francisco near the turn of the century are well known.

Two primary concepts govern the potential for loss from urban fires: fire prevention and fire response. Each of these concepts involve a number of contributing factors which can be thought of as assets and liabilities to fire hazard reduction. These factors are discussed in general in the following paragraphs and Section 2c evaluates the specific conditions in the urban areas of San Luis Obispo County.

b. Structural Types and Fuel Potential

It is difficult to judge which factor is the most important in determining the overall level of risk from fire in an urban area because any one factor can make a critical difference. However, both fire prevention and response are largely a function of what there is to burn within an urban area. Some sections of an urban area may pose unusually high fire risks where the chances of ignition are high and the ability to respond is low. Other areas may not have any particularly serious problems. Within most urban areas, the most serious fire problem involves residences and other types of buildings. Each year in cities there are also a number of rubbish and grass fires, vehicles fires, and aircraft and ship fires at airports and harbors. The primary concern in the urban areas of San Luis Obispo County, however, is with structure fires.

Structure fire problems are basically a function of the type of construction and the type or use of the facility. Construction types in most cities may be thought of as four kinds with respect to fire hazard: fire resistive, non-combustible, ordinary, and wood frame. Fire resistive construction encompasses a broad range of construction types and is generally defined as construction to resist the spread of fire. This means incorporating such measures as fire blocks in the walls, treated shingle roofing tiles, treated paneling, and automatic sprinkler systems. Fire resistive requirements do not allow any material other than "resistive" or "protected". Details of the fire resistive construction are spelled out in the local fire codes. Non-combustible construction is limited to all metal buildings. Ordinary construction includes brick construction which is typified by masonry walls, joisted floors, interior partitions and roof structures of wood, and heavy timber construction. Frame buildings are wood construction throughout, and pose the greatest fire hazard.

The type of structure is of central importance in determining both preventive measures and response strategies. What a structure is used for is a main factor in determining the overall size of the building, its layout, occupancy levels, flammibility of contents, its private protection facilities, and overall hazards to life. Table 2 presents a summary evaluation of the fire hazards of various types of facilities. This table is generalized and should not be construed as a summary of hazards in San Luis Obispo County. Rather, it lists potential hazards. Of special concern to public safety are the following types of facilities: residential buildings, multi-story buildings, hospitals and medical facilities, indoor public assembly facilities, and industrial facilities. Each is discussed

TABLE 2
STRUCTURAL FIRE HAZARDS EVALUATION

TYPE OF BUILDINGS	CONTENTS	LIFE	SPECIAL PROBLEMS
Government	Low	Considerable	Open wells and concealed spaces accelerate spread of fire. Locked doors in jails.
Institutional	Low	Severe	Locked doors, exits in assembly rooms, frequently insufficient water supply.
Amusement	Low	High (when crowded)	Flimsy construction, quick-burning materials.
Single and multiple dwellings	Low	Considerable	Buildings close together, wood single roofs. Combustible rubbish. High frequency of fires in low-grade hotels and rooming houses.
Office	Low	Low	Small office buildings of combustible material.
Department Stores	Moderate	High (during peak shopping periods)	In small stores, congested stock, often lacking sprinklers.
Wholesale mercantiles, single occupancy	High	Low	Stock piled too high for sprinkler control.
Shopping Centers	High	Possible	Lack of openings. Congestion, long lays from public hydrants.
Railroad and wharf property	Moderate	Low	Access obstructed by railroad cars and tracks, wharves accessible from one end only, underdecks wholly inaccessible. Many buildings not sprinklered.
Lumber yards	High	Low	Flying brands, concentration of large amounts of burnable material.
Bulk oil storage	High	Possible	Supplies of foam needed for large plants.
Garages & Filling Stations	Low	Low	Unprotected steel roof trusses and wood roofs subject to collapse in fire.
Industrial	Varies with character of material mfg, and process employed	Low	Special process hazards.

Taken from: Municipal Fire Administration, International City Managers Association, 1967.

in general terms in the following paragraphs.

It should be remembered that the following represents a summary of potential hazards. Local fire and building codes in San Luis Obispo County recognize and prohibit many of these hazards.

(1) Residential Buildings

Single-family detached houses form the major portion of the housing stock in San Luis Obispo County. Fires occur more frequently in private homes from a variety of causes, with human carelessness chief among them, and more lives are lost in residential fire, than in any other type of fire. One particularly dangerous hazard in residential fires is the use of untreated wood shingles in roof construction. Windy conditions could spread the fire to a large number of other houses where this type of roof is common.

Perhaps the most dangerous type of residential building is the low-grade hotel or rooming house. These buildings are characterized by open stair wells, substandard electrical wiring, and often faulty heating systems. Upon ignition, fires in this type building spread rapidly throughout the structure minimizing the opportunities to escape.

(2) Multi-Story Buildings

Buildings over 5 stories pose difficult fire control problems. The large number of occupants and their dependence on internal support systems such as water pressure systems, ventilation systems, and elevator systems increase the potential for disaster. Adequate response to high-rise fires requires special equipment such as helicopters and aerial ladders.

(3) Hospitals and Medical Facilities

These facilities present critical fire control problems. Damage to sophisticated medical equipment by fire threatens the lives of present and future patients. Those mentally or physically debilitated cannot react during crisis in a way that would ensure minimum safety hazards. In times of emergency, ailments are aggravated by stress, and the medical staff is usually inadequate to provide enough aid and guidance.

(4) Indoor Public Assembly Facilities

Public assembly facilities are defined as those in which large numbers of people congregate in generally unfamiliar surroundings. They include schools, theaters, churches, temples, and a variety of recreational facilities. There are a number of these buildings in the study area including several schools. Gatherings of large numbers of people in these buildings create conditions conducive to mass panic in a crisis, which only worsens and increases the casualties. Administering medical aid is made more difficult in these situations as well.

(5) Industrial Fire Hazards

Potentially hazardous industrial operations encountered in the study area include utility lines such as gas lines and overhead electrical power lines. While the normal construction of utility lines provides a high degree of safety, gas lines can break and power lines can come down and result in fires. They should not be overlooked as fire hazards.

c. Fire Prevention

In addition to the available stock of combustible material in a city, fire prevention focuses on the location and arrangement of fire hazardous land uses, public awareness of fire hazards, and the available data base regarding hazards. Considering the location of land uses with respect to fire hazard can be an important preventive measure. In areas of high wildland fire risk, it may be considered unacceptable to build certain types of facilities unless measures are required at the site to mitigate the risk. So too, high density development may be considered unacceptable from the viewpoint of fire hazards because fires have greater opportunity to spread

rapidly, and cause more damage in higher density developments. These are planning considerations and should not be construed as rules of fire prevention. Mitigation measures are available that will offset the fire hazard that exists in high density areas. In addition, fire is only one factor that should be considered in the planning process, and mitigation measures at the site design level can make high density or location near high risk brush fire areas acceptable. However, location and density are major factors governing urban fire hazards.

As with all preventative measures, it is hard to measure the effectiveness of public awareness of fire hazard as a deterent to fire starts. It is known, though, that human carelessness is the greatest cause of urban fires. Public knowledge of the causes of fire, especially in their own homes or businesses, is the starting point for reducing hazard. Its value cannot be underestimated. In the same way, an adequate technical data base of fire hazards in an area is an invaluable tool to the professional fire-fighting organization. Detailed knowledge of the location and type of potential fire problems in a jurisdiction is the necessary basis for implementing preventive measures and planning response strategies.

d. Fire Response

The traditional mission of fire-fighting administrations includes both fire prevention and response once a fire starts. Responde strategies have three major objectives: (1) prevent loss of life and property when a fire starts, (2) confine the fire to its origin, and (3) put out the fire. The principal factors contributing to successful fire response involve both the urban planning process and the application of fire control technology.

Adequate fire response means getting sufficient equipment and manpower to a fire quickly enough to reverse the course of the fire. Response time is usually measured from the time of alarm to the time fire-fighting units arrive at the scene. It is a critical factor in minimizing fire loss, and is a function of the time it takes to detect a fire, the number and locations of fire stations, the access routes to the fire, and the quality of street numbering systems. Of highest importance to saviang lives is the early detection of fire, especially in residences. Installation of smoke detectors in private residences is an effective means of early detection. All of these factors are important considerations to include in the planning process.

Another major factor in fire response is the available flow of water to surrpess the fire. The term fire flow refers to the delivery rates of water that should be maintained to adequately halt and reverse the spread of fire. Optimum fire flow requirements range from a minimum of about 500 gallons per minute (for 2 hours) to about 5000 gallons per minute (for 5 hours) depending on the type of land use. Single-story residential building fires can be contained and extinguished with a 500 gpm fire flow, but high rise construction or large commercial developments necessitate the higher fire flows of about 5000 gpm. In some of the more recent single-family residential construction, 500 gpm is considered too low for 1000 gpm is becoming a more realistic minimum figure.

The type of land use or facility is also a major determinant of the number and quality of personnel, and type of equipment needed to adequately combat fires. For example, high rise structure fires often require the use of aerial ladders, snorkels, and helicopters to deliver the fire retardant. Of course, it is necessary to have trained personnel to operate these more sophisticated types of equipment as well.

As with fire prevention, public awareness plays an important role in fire response. How an individual or group reacts to a fire can mean the difference between efficient evacuation or panic. The value of fire drills cannot be underestimated in assuring safety in the event of a major fire. In addition, a populace that knows to avoid the scene of a major fire, and that does not hinder the work of professional crews provides significant help in controlling fires.

e. City Classification

One of the more important implications of maintaining adequate fire prevention and response abilities is the effect of fire portection on the premiums charged for fire insurance. Within certain limits, the better a city provides for fire protection, the lower the cost of fire insurance. Of course, many factors, such as the type of building and construction, contribute to determining the cost of insurance, but the strength of a city's fire defenses is one of the most important factors.

The level of protection provided by the fire department in a jurisdiction is determined by the Insurance Services Office's (ISO) Standard Grading Schedule. Cities are classified according to the relative value of fire defenses into one of 10 grades, from Class 1 to Class 10. A Class 10 community would be one without a fire department or water supply meeting fire flow requirements while a Class 1 community is one judged most able to cope with fire. As a community improves its fire defenses, its Class improves, and fire insurance premiums on property in the City are lowered. Table 3 shows the distribution of cities in the U.S. according to their fire insurance classifications. Table 3 shows that the majority of cities with populations between 10,000 and 25,000 are in Classes 4, 5, 6, and 7, and the majority of those over 25,000 are in Classes 3, 4, 5, and 6. The Table does not show data on cities under 10,000, but Municipal Yearbook data indicate that the great majority of municipalities under 10,000 are in Classes 7 and 8.

C. Existing Hazards and Response Capabilities

1. San Luis Obispo County

a. Wildland Fire Risk

San Luis Obispo County is exposed to a variety of wildland fire hazard conditions ranging from very low levels of risk along the southcoast portions of the County to extreme hazards in the mountain chaparral stands of the Santa Lucia Mountains. As discussed in the previous section, wildland fire hazards result from the interaction of several factors, both natural and man-made. The Wildland Fire Hazards Map for San Luis Obispo County displays the relative hazard zones, and is a result of the synthesis of the major factors discussed in the preceeding section of the report.

The major fire problems within the County occur in the Santa Lucia Mountains, and the Irish Hills area. These areas exhibit the combination of vegetative fuel type, topography and human proximity that result in extreme hazards. The two "most" significant firé prone locations are, 1) areas west of Santa Margarita where, through the years, numerous fires 50-500 acres in size have occurred; and 2) an area west of Nipomo, where numerous fires 50-300 acres in size have occurred. Another fire prone area adjoins Nacimiento Reservoir to the southwest. There, in 1960, the largest wildland fire in the recorded history of San Luis Obispo County occurred, consuming over 80,000 acres.

Fires, of course, are capable of occurring in any fire risk level, however, they are more likely to occur in the "high" and "extreme" risk areas. Table 4 compiled from Division of Forestry records of all major fires occurring outside of Los Padres National Forest, lists the extent of each fire in approximate acres, the general location of each burn, and the relative hazard level of each burn area (based on the findings of this analysis).

TABLE 3
DISTRIBUTION OF CITIES OVER 10,000 BY TOTAL FIRE INSURANCE CLASSIFICATION AND CLASSIFICATION OF FIRE DEPARTMENT

	Total Fire Insurance Classification[1]									
	All Cities over 25,000							Total Class--Cities 10,000 to 25,000	Classification of Fire Department[2]	
Fire Insurance Class	Number in each Class	Percent in each Class	Cities over 50,000	250,000 to 500,000	100,000 to 250,000	50,000 to 100,000	25,000 to 50,000		Cities over 25,000	Cities 10,000 to 25,000
1	0	0.0	0	0	0	0	0	0	7	0
2	18	2.7	10	4	1	3	0	0	38	8
3	161	24.2	10	21	38	56	36	20	108	21
4	189	28.4	1	0	29	53	106	113	139	57
5	172	25.8	0	0	7	44	121	253	125	129
6	106	15.9	0	0	1	15	90	333	111	226
7	19	2.9	0	0	0	3	16	128	91	223
8	1	.1	0	0	0	0	1	28	23	132
9	0	0.0	0	0	0	0	0	1	3	39
10	0	0.0	0	0	0	0	0	0	2	18
Reporting	666	100.0	21	25	76	174	370	876	647	853

Source: The Municipal Year Book, 1966

[1] Where a city is given more than one grading, it is entered at the lowest total class.

[2] The fire rating bureaus for Wyoming, New Mexico, and Colorado do not issue fire department classification ratings as such; however, fire department deficiency points are included in the total rating.

TABLE 4
HISTORIC WILDLAND FIRES

Date of Occurrence	Location	Acreage (approx.)	Fire Risk Zone
1931	Frog Pond Mountain	700 acres	Extreme
1931	Portola Road (Atascadero)--Santa Rita one fatality	28,000 acres	Extreme
1933	Rinconada Area	15,000 acres	High
1937	North of Cambria Hearst Ranch	10,000 acres	Extreme
1938	Paradise Valley	750 acres	Extreme
1938	Bailey	250 acres	Extreme
1939	Cerro Alto--Cathleen Valley Eagle Ranch, Santa Margarita Ranch	15,000 acres	Extreme
1939	American Canyon	30,000 acres	Extreme
1939	Freeborn Mountain	4,000 acres	High
1940	Las Politas (jumped road, river)	7,000 acres	Extreme
1942	Behr--Huasna area	400 acres	High
1942	Tri-County Fire, NE County--SLO, Kings, Kern	1,400 acres	High
1942	SLO/proximity of the City Coon Creek	700 acres	Extreme
1942	Vasquez boat		Extreme
1947	Dover Canyon	600 acres	Extreme
1947	Cuyama Highway Taylerlyn Fire	10,000 acres	High
1949	Steelbridge Fire-Pozo	4,000 acres	Extreme
1950 July	Pine Ridge Huasna to USFS	17,000 acres	Extreme
1950	Pilatas--to Creston No structure loss--4 fatalities, 1 CDF, 3 N.G.	33,000 acres	Extreme
1950	Hillman Ranch--East of Paso Robles	10,000 acres	High
1951	Black Mountain Navajo fire Pozo grade		
1951	Nacimiento Lake--Godfrey	3,000-4,000 acres	High
1952	Bonheim Ranch	1,000 acres	Extreme
1952	Blue Goat Fire--South of Creston	500 acres	Extreme
1952	Pink Goat Fire	300 acres	Extreme
1952	Caliente Mountain-east side	4,000 acres	High

TABLE 4
(con't.)

Date of Occurrence	Location	Acreage (approx.)	Fire Risk Zone
1953	Buckhorn Ranch (burned into USFS)	13,500 acres	Extreme
1953	Sam Jones--Monterey County burned into SLO County	300+ acres in SLO only	High
1953	Los Berros Canyon--Delasi fire	7,000 acres	High-Low
1953	Ocean View fire	600-700 acres	Extreme
1955	Bee Rock	4,000 acres	High
1955	Iron Springs-Huero Creek	2,000 acres	Extreme
1957	Nacimiento	700 acres	Extreme
1959	Creston--Union School	400 acres	Extreme
1960	Wefferling--SLO acres	80,000 acres	Extreme
1970	Shell Creek	20,000 acres	High
1970 October	Buckeye--from USFS to CDF	500-600 CDF 44,000 acres on USFS	Extreme
1970	Alfafa Ranch Fires	20,000 acres	High
1970	Santa Margarita	4,000-5,000 acres	Extreme
1970	Pilatas	1,000 acres	Extreme
1971	Parkhill fire	2,700 acres	Extreme
1972	Nipomo Mesa and Eucalyptus Fires	300 acres	High
1972	Donati	700 acres	High
1972	See Canyon	400-500 acres	High
1973	Santa Margarita--Calf Canyon	3,500 acres	Extreme
1973 July	Tri-County Fire	3,000 acres	High

Source: California Divison of Forestry, 1975.

Other major fires have occurred within Los Padres National Forest, an area located entirely within the "High" and "Extreme" hazard levels.

Responsibilities for the prevention and abatement of wildland fires belong to the U.S. Forest Service (USFS) in areas contained within Los Padres National Forest, and to the California Division of Forestry (CDF) in wildland areas outside of the forest boundaries. Both of these agencies maintain numerous stations throughout their jurisdictions, each equipped with wildland-oriented fire equipment, and trained personnel.

Because of its responsibilities and its large area of jurisdiction, the California Division of Forestry stands as the major fire fighting force in San Luis Obispo County. The Division maintains 13 fire stations in, or near the communities or location of, San Luis Obispo, Cayucos, Cambria, Nipomo, Santa Margarita, Paso Robles, Simmler, Shandon, Parkfield, Cottonwood, Bradley, Las Tablas, and Cuyama. Equipment inventories vary from station to station, and include fire engines (both 2- and 4-wheel drive), bulldozers, air companies, air tankers, and helicopters.

Fires of moderate significance draw responses from several stations in the nearby area. Since all division stations function as part of one organization, and share a uniform communications network, mobilization efforts proceed with efficiency. In the event of a major fire, local stations could seek almost unlimited assistance from other CDF stations in the central coast region, and throughout the State, if necessary.

Fire abatement in Los Padres National Forest is the responsibility of the U.S. Forest Service, a federal agency charged with land use regulation and watershed management in the nation's forest lands. Since the USFS is involved primarily with the management and protection of the wildlands, they have a great deal of experience in combatting fires of a brush and timber nature. USFS staff fire stations in the areas of Cuesta, Pozo, Pine Canyon, La Panza, Pacific Valley, and White Oak. Station inventories and personnel are similar to those for CDF facilities in the area. Forest Service fire stations possess coordinated response capabilities similar to the CDF in that they operate within one organization and communication system.

The CDF and the USFS have entered into a mutual aid agreement for the purposes of wildland fire protection in San Luis Obispo County. Mutual aid in fire protection has been defined as a reciprocal arrangement in which a number of fire protection agencies share personnel and equipment during emergency situations. Large scale multi-agency responses to wildland fire would probably require several hours for the proper mobilization and delivery of personnel and equipment to the target area.

Both agencies have developed elaborate response strategies for specific areas in specific types of weather, to better prepare for the numbers of variables that exist in wildland fire abatement. For example, the Division of Forestry (CDF) has zoned the entire County as to the types and sizes of fires to be expected during three levels of fire weather. Each possibility has been tabulated on a "Wildland Response Card" which is available to all CDF and USFS stations throughout the County. Also contained on the response cards are precise coordinate locations of the area in addition to the pre-determined strategy (i.e., approach, pieces of equipment, and numbers of personnel to be deployed.) Planning efforts such as this markedly increase the efficiency of fire response in the wildland portions of the County.

2. Urban Fire

This discussion of "urban fire" in San Luis Obispo County is limited to the risk of structural fire in the rural portions of the County, which are outside existing community fire protection districts. In recent times, rural San Luis Obispo County has experienced growth pressures that have impacted its existing fire fighting resources. Personnel and equipment for structural protection in the rural portions of the County come from the County, the California Division of Forestry, and volunteer fire departments maintained in population centers throughout the rural areas. Authority and administrative responsibilities for rural fire protection have been assigned to the State Forest Ranger-in-Charge of the California Division of Forestry, San Luis Obispo Ranger Units, who also functions as the County Fire Warden/Fire Chief.

For the purposes of local planning, three general levels of fire protection personnel currently exist in the County. A description of each level, along with average costs is as follows:

LEVEL I - per year - $ 1,900.00

Volunteer Fire Company with an average of ten (10) paid call men per company. Cost assumes 10 men attending 24 training drills per year @ $5.00 per man per drill and 7 men responding to 20 fires per year @ $5.00 per man per fire.

LEVEL II - per year - $36,736.00

One (1) Fire Apparatus Engineer (FAE), 24 hours per day, with direct support provided by a Volunteer Fire Company. Cost assumes Level I cost plus FAE.

LEVEL III - per year - $ 5,030.00

One (1) Fire Apparatus Engineer, 24 hours per day and one (1) Fireman, 24 hours per day. At present, there are two concepts of Level III manning being used.

1. Per year - $27,667.00

   Five and one-half (5½) months, CDF non-fire season similar to Paso Robles Station.

2. Per year - $60,364.00

   Year-long protection, similar to Nipomo Station.

Currently, four professional fire-fighting facilities and three rural volunteer fire departments offer outlying structural protection throughout the County. A description of each station along with the relative levels of protection and budgetary costs are included in the following table:

TABLE 5
EXISTING RURAL STRUCTURAL FIRE PROTECTION FACILITIES
SAN LUIS OBISPO COUNTY

PROFESSIONAL SERVICES

oSimmler - California Valley $36,487.00*

Fire Engine - County Owned

Level II---
Fire Apparatus Engineer - 1 man - 24 hours per day - 12 months

Additional personnel supplied by Volunteer Company to provide a minimum of two (2) men on the fire engine at the scene of the emergency.

* - Includes salaries, vehicle and radio maintenance, supplies, gas and oil. Service District pays utilities, office space, personnel and apparatus housing.

oNipomo $62,880.00*

Fire Engine - County Owned.

Level III---
Fire Apparatus Engineer - 1 man - 24 hours per day - 12 months.

Fireman - 1 man - 24 hours per day - 12 months.

* - Includes salaries, vehicle and radio maintenance, supplies, utilities, gas and oil. CDF housing, office and equipment storage.

oSan Luis Obispo $28,500.00*

Fire Engine - State Owned

Level III---
Fire Apparatus Engineer - 1 man 24 hours per day - 5½ months.

Fireman - 1 man - 24 hours per day - 5½ months. (This provides professional services during non-fire season.)

* - Includes salaries, vehicle, and radio maintenance, supplies, utilities, gas and oil. CDF housing, office and equipment storage.

oPaso Robles $28,990.00*

Fire Engine - State Owned.

Level III---
Fire Apparatus Engineer - 1 man - 24 hours per day - 5½ months.

Fireman - 1 man - 24 hours per day - 5½ months. (This provides professional services during non-fire season)

* - Includes salaries, vehicle and radio maintenance, supplies, utilities, gas and oil. CDF housing, office nad equipment storage.

BATTALION CHIEF, DISPATCH, TRAINING AND CLERICAL $71,010.00*

Battalion Chief - 12 months
Training Officer, Fire Captain - 12 months

TABLE 5
(con't.)

Dispatch - 24 hours per day - 5½ months CDF non-fire season
Clerical - half-time
Fire Apparatus Engineer - County-wide Relief - 12 months
Radio Maintenance and Telephone Cost Sharing.

VOLUNTEER FIRE COMPANIES (VFC)

oSimmler $1,300.00*

Level II---
10 volunteers provide Level II manning for Engineer

* - Includes expenses for volunteers responding to fires and drills.

oSan Simeon $1,487.00*

Fire Engine - presently owned by VFC

Level I---
10 Volunteers respond with VFC fire engine

* - Includes expenses for volunteers responding to fires, drills and radio maintenance. Apparatus housing, supplies, vehicle maintenance, utilities, supported by VFC.

oOak Shores $1,486.00*

Fire Engine - presently owned by VFC

Level I---
10 volunteers - respond with VFC fire engine

* - Includes expenses for volunteers responding to fires, drills and radio maintenance. Apparatus housing, supplies, vehicle maintenance, utilities, supported by VFC.

oSleeper Program $3,000.00*

Wages, insurance - 4 men - 5½ months (CDF non-fire season)

2 - San Luis Obispo
1 - Paso Robles
1 - Nipomo

In an effort to provide the most efficient, and cost effective structural fire protection throughout rural San Luis Obispo County, a 15-minute response time was selected as the level of protection to be maintained. However, the growth of rural communities has rendered existing response capabilities below the desired 15-minute level. To help alleviate that problem, and provide more effective, overall fire abatement, additional stations have been proposed to become part of the San Luis Obispo County Fire Department. Table 6 lists these stations along with the structural improvements, populations, and occurrence of fire within 15 minutes of the proposed stations.

TABLE 6
PROPOSED FIRE-FIGHTING FACILITIES
SAN LUIS OBISPO COUNTY

Station	Improvement(a)	Population(b)	Level of Protection	5-Year Fire Occurrence(c)	1974 Fire Occurrence(c)	1974 Non-Fire(d) Emergencies
San Luis Obispo:						
Rural	$41,734,898.00	7,572	III	230	72	38
Airport	4,858,040.00	-----	II	---	--	--
(e) Airport Aircraft	1,401,300.00	-----	---	---	--	--
Nipomo:	12,611,414.00	9,702	II	379	95	63
Santa Margarita:	1,950,748.00	1,125	III	83	45	20
Cambria (f):	21,499,145.00	1,120	III	21	10	12

(a) Taxable wealth-improvements are exclusive of land, utilities and unsecured property. Assessors Office.

(b) Population - Planning Department.

(c) CDF Fire Statistics - 1969 - 1973 and 1974.

(d) CDF Non-Fire Emergencies - 1974 - Rescue, flammable liquid hazards, public safety assists, etc.

(e) Commercial and private aircraft values - Tax Collectors Office.

(f) Exclusive of Hearst Castle and Contents.

Source: Rural Structural Fire Protection Plan 1974-75 San Luis Obispo County.

2. City of San Luis Obispo and Vicinity

a. Wildland Fire Danger

Weather, vegetation and topography combine in San Luis Obispo to create one of the more hazardous wildland fire situations in the county. Critical "fire weather" is frequent. The city is surrounded by significant stands of flammable vegetation. And most of the area is hilly -- much of it steep. The greatest fire danger exists where both steep terrain and highly flammable vegetation are part of the mix, but in some places one factor might be so severe that it warrants the highest possible fire-danger designation.

On fire-danger maps for the San Luis Obispo area, weather is assumed to be the same for all parts of the area. Vegetation and topography are the factors that make danger levels vary from place to place. But since the city is in the most critical fire-weather category, danger levels generally are higher than they would be in areas with less frequent critical fire weather.

Because of its size and location next to potential wildland fire areas, the City of San Luis Obispo had been mapped for this type of hazard at the scale of 1" = 2,000'. Four levels of wildland fire danger have been identified for the area: extreme, high, moderate and low. (The natural hazards map is enclosed with this document.)

Most urban development in the city has occurred in flatter areas, away from the more fire-prone hillsides. That aspect helps reduce the chances of injury and property damage. The urbanization that has occurred outside of the well-defined urban envelope has been restricted to the disturbed grassland areas, designated a moderate fire hazard in this analysis.

Primary responsibility for the abatement of wildland fire risks belongs to the California Division of Forestry and, to a lesser extent, the City of San Luis Obispo Fire Department. The CDF maintains a station on Highway One, north of the city, near the more fire-prone areas.

These are the wildland fire-danger classifications and the types of areas that fit each one:

Extreme Fire Danger

Extreme fire danger occurs in several parts of the study area. These generally are the steepest slopes where access is most difficult, and where vegetation is highly flammable and fully developed -- dense chaparral and oak woodland, for example. They include the upper parts of the Santa Lucia Mountains, Santa Lucia Foothills and other ridges and peaks near San Luis Obispo. Many of these areas have had wildland fire problems in the past.

High Fire Danger

In high-danger areas, slopes are less steep than in extreme-danger areas, but access is still difficult. These areas include, for example, the lower slopes of the Santa Lucia Foothills and the Santa Lucia Mountains. Vegetation in these areas generally is highly flammable, but is north coastal scrub or light chaparral, which won't burn with the same intensity as vegetation in extreme-danger areas.

Moderate Fire Danger

Moderate-danger areas usually are flatter areas dominated by grassy vegetation and scattered oak woodlands, including croplands and well-grazed pastures on lower slopes. Since such vegetation burns with only moderate intensity, and since these areas are not so steep, fire is easier to control. But the potential for wildland fire in these areas cannot be overlooked.

Low Fire Danger

Low-fire-danger areas are dominated by two distinct types: (1) developed areas that don't include significant areas of native vegetation and (2) riparian areas along stream courses. Vegetation in these areas characteristically retains enough moisture in its leaves to effectively retard fire.

"No Danger" or "Nil"

This category usually includes only areas of standing surface water. None is shown in the San Luis Obispo study area. Laguna Lake itself could be classified "no danger," but for mapping purposes it has been averaged into the shoreline and surrounding areas as moderate or low danger.

b. Urban Fire Risk

1. Area Setting

The City of San Luis Obispo, with a population of approximately 35,400 ranks as the largest, most diverse urban center in San Luis Obispo County. Located within or in the vicinity of the city are a major university, multi-story county administrative buildings, a significant percentage of multi-family residential developments, and several commercial districts and industrial areas. In recent years, San Luis Obispo has experienced fairly rapid growth, as is reflected in its increasingly urban nature.

As the City of San Luis Obispo grows, its fire protective forces face increasingly complex fire hazards. Currently, the city has the most diverse urban fire fighting situation in the county. This is not to say that there will necessarily be more fires in San Luis Obispo than in other locations, but the potential for problems is greater in the city than elsewhere in the county.

The city has responded to the growing complexity of its fire fighting situation by developing the largest and best equipped urban fire department in the county. The City of San Luis Obispo Fire Department is charged with the responsibility of fire prevention for the city. It currently operates from three fire stations located in the following areas:

(1) Foothill Boulevard and North Chorro Street
(2) Chorro Street and Marsh Street
(3) Augusta Street and Laurel Lane

A new station under construction at the corner of Madonna and Los Osos Valley roads is expected to be ready for use by the end of May 1978.

The city Fire Department is a full-time professional department employing one chief, three battalion chiefs, one fire marshall, three permanent fire inspectors, two temporary fire inspectors, one investigator, 10 fire captains, nine fire engineers and 12 fire fighters.

The Fire Department's inventory of rolling fire-response equipment includes the following:

4 1250 gpm pumpers
1 85-foot aerial ladder truck
1 75-foot aerial ladder "scope" truck (expected in service by July 1, 1978)
2 reserve pumpers
1 state-owned reserve pumper available to the city

The city's fire defenses are currently ranked by the Insurance Office as Class 3 for the more central portions of the city, and Class 9 for the chiefly undeveloped outlying areas. The primary reason for this decrease in rating is the fact that there is no water available from the city in these areas.

2. Fire Incidence

Data compiled by the city Planning Department over the period 1969-1973 indicates that approximately 178 fires occur annualy in the City of San Luis Obispo. The majority of these fires involve structures, but do not always cause major damage. Kitchen fires, a primary component of structural fire statistics, inflate these figures somewhat above the level of damages actually incurred. The following table indicates the numbers, and types of fire which have occurred in the six major areas of the city.

TABLE 7

FIRE INCIDENCE

CITY OF SAN LUIS OBISPO

	1969				1970				1971				1972				1973				1969-1973			
	STRUCTURAL	VEHICLE	MISC. FIRE	GRASS	STRUCTURAL	VEHICLE	MISC.	GRASS	STRUCTURAL	VEHICLE	MISC.	GRASS	STRUCTURAL	VEHICLE	MISC.	GRASS	STRUCTURAL	VEHICLE	MISC.	GRASS	STRUCTURAL	VEHICLE	MISC.	GRASS
COLLEGE	9	5	1	8	5	5	3	1	5	2	6	3	8	3	5	1	7	5	1	5	34	30	16	18
JOHNSON	14	5	6	16	14	6	4	14	11	7	6	3	20	10	4	11	12	7	7	9	71	35	27	53
FOOTHILL	8	7	5	10	9	10	4	6	23	21	19	11	6	4	2	4	10	3	4	1	56	45	34	32
DOWNTOWN	25	15	13	21	37	17	14	5	11	3	9	11	23	24	10	15	24	21	12	8	120	80	58	60
LAGUNA	3	7	-	7	5	3	4	7	4	6	2	7	4	4	6	8	3	5	5	5	19	25	17	34
EDNA/AIRPORT	-	1	1	3	4	1	1	2	2	2	-	3	4	1	2	-	5	4	1	4	15	9	5	12
TOTALS	59	40	26	63	74	42	30	35	56	41	42	38	65	46	29	39	61	45	30	32	315	214	147	209

SOURCE: City of San Luis Obispo Planning Department

As is illustrated in the preceding table, more fires of each type occur in the City's downtown than in any other single location. This is perhaps to be expected for structural fires and vehicle fires. However, when analyzing grass fire occurrences, such results are somewhat unusual. The probable cause for this is the number of vacant lots, overgrown with weeds, that exist in the downtown area. Children will often seek out these areas during play, and accidentally ignite the accumulated debris with matches or other lighted materials.

3. Response Corridors/Evacuation Routes

Response corridors are defined as primary routes along which emergency vehicles, including fire department equipment, travel when responding to a fire or another emergency. Response corridors are usually primary or secondary roads that offer sufficient width for fire vehicles. Roads chosen as response routes usually follow the most direct paths to the various parts of the community. However, response corridors are often the more attractive routes for general traffic flow: a situation which sometimes results in traffic conjestion and delays in emergency response.

Primary response routes in the City of San Luis Obispo include Higuera Street, Marsh Street, Pismo Street, Johnson Avenue, Broad Street, Madonna Road, Highway 101, Chorro, Santa Rosa, California Blvd., Monterey Street, and Madonna Road for Fire Station #1; Foothill Blvd, Santa Rosa, Monterey Street, California Blvd., Grand Avenue, Chorro Street, Broad Street, Highway 101, and Madonna Road for Fire Station #2; Johnson Avenue, Laurel Lane, Orcutt Road, Broad Street, South Street, and Higuera Street for Fire Station #3. (SLO City Fire Department, 1974).

Evacuation routes as defined in Section VI, Emergency Preparedness, often adhere to major response corridors. Such is the case in the City of San Luis Obispo.

4. Potential Hazards

Potential hazards that exist in any city, including San Luis Obispo, are many and depend on the types and intensities of land uses which occur in the area. However, the implementation of fire defenses serves to reduce the likelihood of hazards to acceptable levels. Maintaining adequate fire flows, response times, personnel and equipment is crucial in preserving adequate levels of fire prevention.

As is reflected in its ISO classification, the City of San Luis Obispo is, in general, well-protected from urban fire. However, some exceptions to this general statement exist. A major fire protection hazard in the City is related to the lack of a fire fighting station to serve the developing areas of Laguna Lake and Los Osos Valley. Fires in these areas cannot be reached from existing facilities within a four-minute period. It has been established that a total elapsed time of four minutes is the maximum time which a citizen should have to wait for the arrival of fire fighting units. The determination of four minutes is based on the fact that most fires in (or endangering) buildings gain sufficient headway so that they are beyond the control capability of firefighting personnel responding from fire stations located more than 2½ or 3 miles from the fire location, or otherwise delayed as the result of heavy-traffic areas, topographic obstructions, etc. (SLO City Fire Department, 1974).

Mitigation measures have been offered by the City Fire Department that would alleviate a portion of the problems associated with unduly long response times until a new facility can be constructed in the south area. These measures are contained in the City's Resolution Number 2774 (1975 Series). Briefly, some of the measures include:

1. Prohibition of construction which will require more than 1500 GPM fire flow flow for fire protection unless approved automatic sprinkler protection is provided.

2. Prohibition of construction of buildings exceeding 5000 square feet in area unless approved automatic heat and smoke detection systems are provided.

3. Prohibition of construction of buildings exceeding two (2) stories in height unless windows required for rescue of occupants can be reached with ladders carried on fire department pumpers.

4. Prohibition of construction of buildings not provided with fire-retardant roof coverings.

5. Prohibition of construction of buildings exceeding 1500 square feet in area unless provided either with (1) wall and ceiling protection such as "one-hour fire-resistive construction throughout", or (2) with automatic sprinkler protection or (3) with installation of automatic smoke detection equipment.

Other fire safety issues that exist in the City include the following:

1. Insufficient fire flows in portions of the City. The Criteria used to define fire flow deficiencies include a minimum requirement of 500 gpm for low and medium density residential areas; and a minimum of 1500 gpm for multi-family residential, commercial and industrial land uses.

   An overlay showing existing land use and fire flows was employed in developing the fire flow deficiency areas that exist in the City. These areas, which appear on the Urban Fire Hazards Map for the City, are generally restricted in size; but are found throughout the developed portions of the City.

2. Response delays associated with traffic congestion. Recent traffic studies available to the City Fire Department indicate that the most heavily travelled surface streets in the City are also utilized as primary response corridors by the Fire Department. The traffic associated with these response routes effectively delays response capabilities for emergency vehicles.

3. Response delays associated with topographical features. San Luis Obispo is a City well-divided by natural topography and man-made surface features. Such separations as the Southern Pacific Railroad, U.S. Highway 101, San Luis Obispo Creek and the mountains to the west of the City effectively bisect the area into many different subareas. The significance of these features becomes more apparent when access is needed during periods of high environmental stress, such as during the flood of January 1973. Disasters of that variety can render already-limited crossings virtually useless to emergency response vehicles.

4. Hazards associated with community infrastructure. The existence of infrastructure (oil pipelines, gas lines, and electrical transmission lines in particular) can increase an area's exposure to fire and explosion. Although facilities of these types are designed to withstand significant environmental disruptions, failures have been known to occur, resulting in pipeline rupture or transmission line collapse. Failures are most likely to be non-seismic in nature (see Section IV C: Effects on Utilities). They are more likely to be caused by faulty pipes, accidental puncturing, or, in the case of power lines, high winds. The City is traversed by several oil, gas and electrical lines that serve the area and transport these commodities to other locations.

3. City of Morro Bay

a. Wildland Fire Hazards

The City of Morro Bay does not face major wildland fire threats due to its environmental setting. Vegetation in the area is limited primarily to low growing grasses and scattered shrubs, the characteristic vegetation of disturbed Northcoastal Grasslands. Another fire-limiting characteristic of this area is the cool, marine-influenced climate. Temperature extremes do not occur very often, nor does the relative humidity decline to critically-low fire hazardous levels.

The only wildland area which deserves special consideration in the Morro Bay is the Black Hill, Cerro Cabrillo area south of the City. Native vegetation in this area approaches levels capable of supporting a localized wildland fire. However, the climate, and land use characteristics of that vicinity make ignition unlikely.

b. Urban Fire Risk

1. General Setting

The City of Morro Bay has a population of 8,875 (January 1975) and ranks as the second largest incorporated city in San Luis Obispo County. In terms of diversity of land uses and overall developed density, the City of Morro Bay ranks below larger cities, such as San Luis Obispo. The fire hazards situation is therefore, less complicated in a city the size and stature of Morro Bay.

The City of Morro Bay Fire Department is charged with the responsibility of fire protection in the City. It currently operates from a single station located at 715 Harbor Street. The Department is staffed by both professional personnel and volunteers, and includes the following:

Professional	Volunteer	Position
1	-	Chief
3	5	Captains
5	8	Engineer
1	7	Fire fighters

The Fire Department's inventory of rolling fire response equipment includes the following:

2 1000 gpm pumpers
1 750 gpm pumper
1 Ton Squad Truck
1 Chief's Car
1 Pickup

In addition to the above equipment, the City also maintains a fire boat which is used in responding to boat, dock, pier, and general waterfront fires. A subsidized private ambulance is also available for emergency response in the City.

The City's fire defenses are currently rated by the Insurance Services Office as Class 5 for the more central portions of the City and Class 9 for the beach area and outlying locations to the east and south. The primary reason for this decrease in protection rating is the lack of water and adequate response routes in these areas. Response to fire emergencies in the City proper requires a maximum of four minutes.

2. Potential Hazards

Four potential urban-oriented fire hazardous situations exist in the Morro Bay area. They are:

1) Inadequate water supplies in the more northerly-sections of the City.

2) Poor access in and around the waterfront areas during tourist season.

3) Access problems associated with operation from one fire station.

4) The existence of the Pacific Gas and Electric Power Plan and supporting tank facilities.

The fire problems associated with inadequate water supplies are Morro Bay's major problem, relative to the other three. As is indicated on the Natural Hazards Map, the City of Morro Bay, certain areas along Sequoia Avenue, Aldea Avenue, and Atascadero Road do not possess adequate water supplies. This requires the City Fire Department to lay longer hose lengths when combatting fires in these areas. This problem is recognized by the City which plans to upgrade fire flows in the City according to the priority areas shown on the Natural Hazards Map.

Access to the beach area, the second fire problem, is seasonal in nature and is caused by the traffic congestion and parking violations which commonly occur in that area. Emergency responses to dock fires or boating emergencies could be hindered by congestion in this location.

The third problem is of somewhat lesser significance, but still warrants consideration. Fire departments that operate from one station run the risk of being isolated from potential emergencies if critical transportation links become jeopardized during periods of extreme environmental stress. Such a situation is possible in the City of Morro Bay. Emergency access to the northerly sections of the City is directly linked to the passability of Highway One across Morro Creek. Although the bridge is not susceptible to more periodic floods, its performance has never been tested during a storm producing a flood of the 100-year frequency.

Fire protection in smaller cities and communities is often limited to a central facility which serves the entire community. Therefore, this problem is commonly encountered in such areas. Morro Bay has, in the past, operated a station in the north city. If population trends continue, and the north area continues to grow in terms of population and structural units, it may become necessary to reopen a north city facility. The City is considering locating a new station at the southeast intersection of Highway 46 and North Main Street.

The fourth fire problem is associated with the existence and functioning of the Morro Bay electrical generating facility operated by the Pacific Gas and Electric Company. Although units of this type have substantial safety precautions engineered into their design, certain risks still remain.

The community itself is faced with greater risk from the infrastructure which transports resources to and from plants of this type.

The existence of infrastructures (oil pipelines, gas lines, and electrical transmission lines in particular) can increase an area's exposure to fire and explosion. Although facilities of these types are designed to withstand significant environmental disruptions, failures have been known to occur resulting in pipeline rupture or transmission line collapse. Failures are most likely to be non-seismic in nature (see Section IV C: Effects on Utilities). They are most likely to be caused by faulty pipes, accidental puncturing, or, in the case of power lines, high winds.

3. Response Corridors/Evacuation Routes

Response corridors are defined as primary routes along which emergency vehicles, including fire department equipment travel when responding to a fire, or similar emergency. Response corridors are usually primary or secondary roads that offer sufficient width for fire vehicles. Roads chosen as response routes usually follow the most direct paths to the various parts of the community. However, response corridors are often the more attractive routes for general traffic flow: a situation which sometimes results in traffic congestion and delays in emergency response.

Primary response routes in the City include Morro Bay Boulevard, Harbor Street, Main Street, Highway One, Kern Avenue, Atascadero Road, and South Bay Boulevard.

Evacuation routes as defined in Secton VI, Emergency Preparedness, often adhere to major response corridors. Such is the case in the City of Morro Bay.

4. City of El Paso de Robles

a. Wildland Fire Hazards

The City of El Paso de Robles is situated in the Southern Salinas River Valley, adjacent to the foothills of the Santa Lucia Range. The climate of the area is moderate, and is characterized by dry, warm summers and moderately wet winters. The climatic influence and physiography of the region, which includes Paso Robles, have provided the necessary components for a variety of natural vegetative types. Extensive oak woodlands, grasslands and stands of chaparral occur in various areas of the regions. All of these plant communities contribute to a relatively high degree of wildland fire risk. However, most of the development in the Paso Robles area has occurred in the flatter portions of the area, away from the more fire prone hillside locations. What development has occurred to the west of the City, has been basically agricultural in nature, a land use which mitigates much of the risk associated with wildland fire.

The risk of wildland fire in the Paso Robles area is localized and moderate, and is basically confined to those low density residential areas located near growths of significant native vegetation. Those areas include the Norn Hill and Peachy Canyon areas, both of which are outside the City proper.

b. Urban Fire Risks

(1) General Setting

Paso Robles is a mature, moderately well developed urban area with a population of approximately 8,195. It is the County's fourth largest incorporated City, and the fifth largest urban center. The City also operates the Paso Robles Municipal Airport, the second busiest public airport facility in the County (based on numbers of operations). Land uses in Paso Robles are essentially residential, commercial, and agricultural, with single family structures and commercial shops comprising most of the City's structural types. The City also has a number of industrial companies which are involved in the production of electronic components, printed business forms, and wholesale meat. One of the leading industrial complexes is an almond processing plant.

The City of Paso de Robles Fire Department is charged with the responsibility of fire protection in the City. It currently operates from three stations, located at 13th Street and Oak Street, Santa Fe Avenue in the Sherwood Acres area, and The Paso Robles Municipal Airport. The City Fire Department is staffed with a professional fire chief and a complement of 47 volunteer officers and fire fighters.

The Fire Department's inventory of rolling fire response equipment includes the following:

1 150 gpm pick-up
1 1250 gpm pumper
2 1000 gpm pumper
1 850 gpm pumper (reserve)
2 Patrol Units (150-250 gallon capacity)
1 Fire boss unit-450 gallons dry chemical
-50 gallons light water (foam)
1 Rescue Unit (with medical technician for response to Freeway/Highway accidents)

The City's fire defenses are currently ranked by the Insurance Services Office as Class 5 for the more central portions of the City and Class 9 for certain undeveloped eastern areas of the City. The primary explanation for this decrease in protection is the lack of roads in affected areas. Little development has taken place in these lesser protected areas. Response to fire emergencies in the developed portions of the City requires approximately three minutes.

The City Fire Department has entered into mutual aid agreements with the Atascadero Fire Protection District and the California Division of Forestry.

Mutual aid in fire protection has been defined as a reciprocal arrangement in which several fire protection agencies share personnel and equipment during emergency situations. Mutual aid accomplishes an increase in fire protection capabilities at minimal extra cost. However, mutual aid operations usually lack the efficiency of operations involving only one department.

The City responds to approximately 40-45 alarms per year. Of these, approximately one-third (1/3) involve structures, and most of these are limited fires.

Paso Robles is provided with sufficient water supplies for fire prevention. Storage capacity exceeds 8,000,000 gallons in the two City reservoirs, and seven wells at varying depths tap the aquifers created in part by the Salinas River. Few areas in the developed portion of the City are more than 300 feet from a functioning fire hydrant.

(2) Potential Hazards

Potential hazards in the City of Paso de Robles are generally related to (1) the presence of the airport and related industries, (2) Highway 101 and the Southern Pacific Railroad that traverse the City in a north-south direction, and the presence of potentially hazardous utility lines in the City.

Paso Robles Municipal Airport ranks as the second largest airport in San Luis Obispo County, with about 60,000 operations annually. The requirements for fire protection in the event of a crash, emergency landing, or fuel explosion create a significant need for additional safety considerations in the area. These needs are presently met by the fire station operated by the City which is located in the airport area. Evaluations contained within the Master Plan for Paso Robles Municipal Airport, McGlasson and Associates, Consulting Engineers, have found existing protection adequate for maintaining acceptable safety levels.

The Southern Pacific Railroad and Highway 101 traverse the area in a north-south direction. The fire hazards associated with the presence of these facilities relate to the flammable and caustic materials often transported in rail-mounted tank cars and highway trucks. No major disasters of this type have occurred to date, but the possibility of a future accident cannot be precluded.

The third potential hazard arises from the presence of standard energy-dispensing utilities that traverse the area. The existence of infrastructure (gas lines and electrical transmission lines, in particular) can increase an area's exposure to fire and explosion. Although facilities of these types are designed to withstand significant environmental disruptions, failures have been known to occur, resulting in pipeline rupture or transmission line collapse. Failures are most likely to be non-seismic in nature (see Section IVC: Effects on Utilities). They are more likely to be caused by faulty pipes, accidental puncturing, or, in the case of power lines, high winds.

(3) Response Corridors/Evacuation Routes

Response corridors are defined as primary routes along which emergency vehicles, including fire department equipment, travel when responding to a fire, or similar emergency. Response corridors are usually primary or secondary roads that offer sufficient width for fire vehicles. Roads chosen as response routes usually follow the most direct paths to the various parts of the community. However, response corridors are often the more attractive routes for general traffic flow - a situation which sometimes results in traffic congestion and delays in emergency response.

Major response routes in the Paso Robles area include: Vine Street, Spring Street, Pine Street, Riverside Avenue, 13th Street, Niblick Road, Creston Road, U.S. Highway 101 and Highway 46.

Evacuation routes as defined in Section VI, Emergency Preparedness often adhere to major response corridors. Such is the case in the City of Paso de Robles.

5. City of Pismo Beach

a. Wildland Fire Hazards

The City of Pismo Beach is confronted with no significant wildland fire hazards. The potential for fire exists in the Pismo Hills, to the west of the City, where occasional steep slopes and open space interact to create a potentially hazardous area. However, heavy livestock grazing along these hillsides has removed much of the grasses, and lowered the threat of fire in that area. Grazing has been so intense that the hazards caused by erosion outweigh the fire risks in the area.

b. Urban Fire Risk

(1) General Setting

Pismo Beach is a moderately well-developed, recreationally oriented urban area, with a resident population of 5,423 (July, 1974). However, during the summer months the City's population increases by as much as 100% because of influx of summer residents and vactioners.

Urban land uses within the City are primarily residential and commercial. A significant portion of the residential acreage and total structural units in the City are of the medium and high density variety, such as hotels, apartments, and condominiums. These structures, along with the schools, theaters, and other places of assembly constitute the City's most critical areas in regards to urban fire safety.

Pismo Beach is served by the Pismo Beach Fire Department, the agency primarily responsible for the City's fire protection and emergency response needs. It is a volunteer organization, numbering 22 volunteers and headed by a professional fire chief. The Fire Department operates from two facilities, located at Bello and Pismo street (main station), and the Pacific Coast Highway, in the vicinity of the Andrews-Shell Beach area. The Fire Department's inventory of rolling fire response equipment includes the following:

1 1250 gpm pumper
2 1000 gpm pumpers
1 750 gpm pumper
1 500 gpm pumper
2 Rescue Units
1 Utility Jeep

The City Fire Department is capable of responding to an alarm in the developed portion of the City within two minutes. The City's fire defenses are currently rated by the Insurance Services Office as Class 5 for that portion of the City to the west of the Southern Pacific Railroad, and Class 9 for the incorporated areas east of the railroad. Virtually all of developed Pismo Beach is located in the Class 5 protection zone.

The City of Pismo Beach Fire Department has entered into mutual aid agreements with the City of Arroyo Grande Fire Department and the Grover City Fire Department, as well as the California Division of Forestry and the Oceano Volunteer Fire Department. Mutual aid in fire protection is a reciprocal arrangement in which several fire protection agencies share personnel and equipment during emergency situations. Mutual aid accomplishes an increase in fire protection capabilities at minimum extra cost. However, mutual aid operations usually lack the coordination and efficiency of operations involving only one department.

Pismo Beach is generally well supplied with water for the purposes of fire prevention. Fire flows in the principal business district are approximately 3500 gpm, while flows in other commercial and high density residential area average between 2000 gpm and 3500 gpm. A minimum flow of 1000 gpm is maintained in the City's low and medium density residential areas. The City's overall water storage capacity is approximately 2,000,000 gallons in the City's five reservoirs and Lake Lopez allotment. There are fire flow problems

in specific areas, however, which result from the lack of shut-off valves and inadequately sized routes and water lines. This hazard is discussed below.

(2) Potential Hazards

Potential fire hazards in the Pismo Beach area are related to (1) the lack of adequate fire flows in certain areas, (2) the influx of population during tourist season, (3) the potential pressures for high rise development in the City, and (4) the presence of the Southern Pacific Railroad to the east of the City, and Highway 101.

A recent evaluation of the City's water system by the City Engineer concluded that water pressure was inadequate in a number of areas, and that the downtown area water lines were lacking shutoff valves. The areas affected by lack of water pressure are Spyglass Point and parts of St. Andrews. The City Council has recognized the potential hazards created by these fire flow problems, and has authorized engineering studies for placement of 5,000 feet of 16-inch line between Spyglass Point and the water reservoir along Mattie's Road. In addition, approximately 200 feet of 6-inch line between Terrace Avenue and the Lopez turnout will be replaced with 12-inch line.

The population of Pismo Beach increases significantly during the summer months, as has been previously discussed. An emergency situation occurring in conjunction with the tourist season could conceivably exceed the City's fire protective and emergency response capabilities, especially if large evacuations were made necessary. Another aspect related to this situation is the congestion which normally accompanies busy weekends and vacation periods. Access problems, similar to those encountered along Cypress Street throughout the year, are made more likely in the beach area, by the influx of beach-oriented vacationers. Crowded streets could increase the risks of extensive fire damage by impeding the efficient response of both fire equipment and personnel.

Pismo Beach is currently the only City in the Pismo Beach-Arroyo Grande-Grover City area that includes structures over three stories in height. Similarly, it is the City most likely to encounter future pressures for high rise development. Multi-story structures can represent significant potential fire threats. Dependence on internal support systems, including ventilation, water availability and pressure, and elevator systems increase the sensitivity of high-rise structures. Such systems may fail during a fire, when they are most critically needed. Many cities confronted with the potential hazards of high rise development require all multi-storied structures to incorporate sprinkler systems in their design. Of the most commonly available private fire protection facilities, the automatic sprinkler system remains the most effective. Records of more than 120,000 fires show that 96% were extinguished or satisfactorily checked by sprinklers.

The Southern Pacific Railroad and Highway 101 traverse the area in a north-south direction. The fire hazards associated with the presence of these facilities relate to the flammable and caustic materials often transported in rail-mounted tank cars and highway trucks. No major disasters of this type have occurred to date, but the possibility of a future accident cannot be precluded. The Pismo Beach Fire Department assumes the responsibility for fire response along Highway 101 from the South County boundary to Avila Road, north of the City. An emergency situation involving the railroad, however, would involve other local agencies.

(3) Response Corridors/Evacuation Routes

Response corridors are defined as primary routes along which emergency vehicles, including fire department equipment, travel when responding to a fire, or similar emergency. Response corridors are usually primary or secondary roads that offer sufficient width for fire vehicles. Roads chosen as response routes usually follow the most direct paths to the various parts of the community. However, response corridors are often the

most attractive routes for general traffic flow - a situation which sometimes results in traffic conjestion and delays in emergency response.

Response routes for the City of Pismo Beach include: Bello Street, Price Street, U.S. Highway 101, Dolliver Street, Bay Street, El Portal Street, Wadsworth Street, and Five Cities Drive.

6. City of Arroyo Grande

a. Wildland Fire Hazards

The City of Arroyo Grande is located in the generally flat valley drained by Arroyo Grande Creek. The flatter portions of the area have been developed into urban, or agricultural land uses, while the hilly portions of the City to the north and east remain in a semi-natural open woodland state. Certain of these hilly areas represent moderate wildland fire risks to the more outlying portions of the City.

Several factors help mitigate the potential for large fires in the Arroyo Grande area. The natural vegetation of the area is not dominated by the more fire-prone chaparral species, nor are sizeable amounts of plant litter allowed to develop. Cattle grazing helps reduce much of this accumulation.

b. Urban Fire Risk

(1) General Setting

The City of Arroyo Grande has a population of 8,550 (July, 1974) and is the third largest incorporated City in San Luis Obispo County. In terms of diversity of land uses and overall developed density, the City of Arroyo Grande ranks below larger cities, such as San Luis Obispo. The resultant fire hazards situation is, therefore, less complicated in a city the size of Arroyo Grande.

The City of Arroyo Grande Fire Department is charged with the responsibility of fire protection in the City. It currently operates from a single station located at 215 East Branch Street. The Department is staffed with a professional fire chief and a complement of 38 volunteer officers and fire fighters.

The Fire Department's inventory of rolling fire response equipment includes the following:

1 2500 gallon water tanker*
1 1000 gpm pumper
1 1250 gpm pumper
1 Mini-Attack vehicle
1 Rescue vehicle

The City's fire defenses are currently ranked by the Insurance Services Office as Class 5A for the more central portions of the City, and those areas that are unavailable to the City's water system and lack hydrants are assigned a Class 9 for insurance purposes. Response to fire emergencies within the City's built up area does not exceed four (4) minutes.

The City Fire Department has entered into mutual aid agreements with the California Division of Forestry and the fire departments of Santa Maria, Oceano, Grover City, and Pismo Beach. Mutual aid in fire protection has been defined as a reciprocal arrangement in which several fire protection agencies share personnel and equipment during emergency situations. Mutual aid accomplishes an increase in fire protection capabilities at minimal extra cost. However, mutual aid operations usually lack the efficiency of operations involving only one department.

The City recently acquired the mini-attack vehicle listed in the preceding inventory. Its capabilities range from wildland fires to structural fires of limited extent. The mini-attack vehicle is more maneuverable than the larger 750, 1000, and 1250 gallon capacity pumping units, and is capable of performing tasks once thought to be solely within the realm of larger pumping vehicles. In Arroyo Grande, this unit works in conjunction with its larger counterparts in a mini-maxi attack for the majority of emergency assignments.

It should also be noted that the Arroyo Grande Fire Department frequently has eight (8) emergency medical technicians at its disposal, and is well equipped for related rescue assignments and vehicle extrication.

The City Fire Department responds to approximately 80 alarms per year. Of these, approximately 20% involve structures and most of these are limited fire.

*Available on request from Public Works Department.

The City of Arroyo Grande has provided sufficient supplies of water and hydrants for the purposes of fire protection. Few areas within the developed portion of the City are beyond 300 feet from a functioning fire hydrant.

(2) Potential Hazards

Potential hazards in the City of Arroyo Grande are generally related to (1) the presence of certain potentially hazardous land uses, and (2) the lack of multiple fire-fighting facilities in the City. Neither of these potential problems are major concerns, but neither should be overlooked.

The City contains areas of high density residential and light commercial/industrial land uses, each of which requires complex fire fighting strategies. Portions of the City's industrial areas are concerned with the distribution of pesticides, insecticides, and fertilizers. Such chemicals present hazards through fire and explosion, as well as corrosion. High density residential developments concentrate large quantities of combustible materials in confined areas with limited access. Both of these factors complicate fire fighting procedures.

Fire Departments, such as Arroyo Grande's, which operate from a single station, run the risk of being isolated from potential emergencies if critical transportation links become jeopardized during periods of extreme environmental stress or traffic conjestion. However, Arroyo Grande's location helps minimize the risk of occurrence. In an emergency, the City Fire Department. Both of these agencies are located in sufficient proximity to offer assistance within minutes.

A third potential hazard arises from the presence of standard energy-dispensing utilities that traverse the City. The existence of infrastructure (e.g. oil pipelines, gas lines, and electrical transmission lines, in particular) can increase an area's exposure to fire and explosion. Although facilities of these types are designed to withstand significant environmental disruptions, failures have been known to occur, resulting in rupture or transmission line collapse. Failures are most likely to be non-seismic in nature (see Section IIIC: Effects on Utilities). They are more likely to be caused by faulty pipes, accidental puncturing, or, in the case of power lines, high winds.

(3) Response Corridors/Evacuation Routes

Response corridors are defined as primary routes along which emergency vehicles, including fire department equipment, travel when responding to a fire, or similar emergency. Response corridors are usually primary or secondary roads that offer sufficient width for fire vehicles. Roads chosen as response routes usually follow the most direct paths to the various parts of the community. However, response corridors are often the more attractive routes for general traffic flow: a situation which sometimes results in traffic congestion and delays in emergency response.

Primary response routes in the City of Arroyo Grande include Branch Street, Traffic Way, Valley Road, Cherry-Branch Mill Road.

Evacuation routes as defined in Section VI, Emergency Preparedness, often adhere to major response corridors. Such is the case in Arroyo Grande.

7. Grover City

a. Wildland Fire Hazards

Grover City is confronted with no major wildland fire hazard risks. Its location, adjacent to the Pacific Ocean and away from vegetated hillsides possessing heavy potential fuel loads, effectively reduces wildland fire hazards. Open areas, populated by annual grasses, still exist within the City, but insufficient fuel is present to maintain large scale natural fires. Smaller fires might break out in these grassy areas during the drier months of late summer, though it is doubtful they would spread far beyond the point of ignition.

b. Urban Fire Risk

(1) General Setting

Grover City, with a December, 1974 population of 7,225 (Department of Finance) comprises approximately 2.3 square miles of land area west of Arroyo Grande, adjacent to the Pacific Ocean. Approximately 27% of the City's total land area has undergone urban development, while the remaining 73% has been used for agriculture, recreational open-space and public rights-of-way (Grover City Land Use Element, 1973). Most urban development that has occurred in the City has been single family residential construction (accounting for approximately 21% of the residential acreage, and over 90% of the total housing stock.) Of the remaining 6% of urban land use, various forms of medium and high density residential development account for approximately 2%, commercial enterprises contribute approximately 2%, industrial uses (primarily service-oriented) account for approximately 0.3%, and public and quasi-public uses account for approximately 2%.

The type of low density urban form which occurs in Grover City results in a fairly uncomplicated urban fire situation. The City is protected from fire by the Grover City Fire Department, a volunteer organization numbering 22 volunteers, and headed by a professional fire chief.

The Fire Department operates from a single facility located at 867 Ramona Avenue. The Fire Department's inventory of rolling fire response equipment includes the following:

1 1250 gpm Pumper
2 1000 gpm Pumpers
1 Rescue Panel Truck
1 Utility Vehicle

The Grover City Fire Department is capable of responding to an emergency within the City limits within four minutes.

The City's fire defenses are currently rated by the Insurance Services Office as Class 6 for the entire City area. The City Fire Department has entered into mutual aid agreements with the City of Pismo Beach Fire Department and the City of Arroyo Grande Fire Department. Mutual aid in fire protection is a reciprocal arrangement in which several fire protection agencies share personnel and equipment during emergency situations. Mutual aid accomplishes an increase in fire protection capabilities at minimum extra cost. However, mutual aid operations usually lack the coordination and efficiency of operations involving only one department.

(2) Potential Hazards

Potential hazards in Grover City are related primarily to (1) the presence of the Southern Pacific Railroad, (2) the deficiency of hydrants in some portions of the City, and (3) the lack of multiple fire-fighting facilities in the City.

The Southern Pacific Railroad traverses the area in generally a north-south direction, adjacent to the western boundary of the City. The fire hazards associated with its presence relate to the flammable and caustic materials often transported in rail-mounted tank cars. No major disasters of this type have occurred to date,

but the possibility of a future accident cannot be precluded. The Grover City Fire Department, along with other local agencies, would be relied upon for any fire or chemical emergency a railroad accident might create.

Certain areas within the urban envelope of Grover City have deficient fire hydrant coverage. Developed areas that are more than 300-350 feet from the nearest fire hydrant appear on the Natural Hazards Map for Grover City. These areas include the following:

1. Southern Pacific Railroad and Rockaway Avenue
2. South Eighth Street and Longbranch Avenue
3. South Tenth Street and Seabright Avenue (Grover City Elementary School)
4. South Tenth Street and Ramona Avenue
5. Atlantic City Avenue and North Tenth Street (Grover Heights Elementary School)
6. North Eleventh Street and Saratoga Avenue
7. First Street and Newport Avenue
8. Brighton Avenue and North Third Street

Deficient hydrant spacings force fire fighting personnel to lay longer lengths of hose to deliver water to a fire. Excessive hose lengths require more time for placement, and result in lower pressures of water at the point of delivery. Of special significance is the lack of hydrants in the areas of Grover Heights Elementary School and Grover City Elementary School. These facilities are of a major critical nature both as school sites and as potential evacuation centers during crisis situations.

Fire Departments in areas such as Grover City that operate from a single station, run the risk of being isolated from potential emergencies if critical transportation links become jeopardized during periods of extreme environmental stress, or traffic congestion. However, Grover City's location helps minimize the risk of such an occurrence. In an emergency, the City Fire Department could request assistance from local fire departments, including the Arroyo Grande Fire Department and the City of Pismo Beach Fire Department. Both of these agencies are lcoated in sufficient proximity to offer assistance within minutes.

(3) Response Corridors/Evacuation Routes

Response corridors are defined as primary routes along which emergency vehicles, including fire department equipment, travel when responding to a fire, or similar emergency. Response corridors are usually primary or secondary roads that offer sufficient width for fire vehicles. Roads chosen as response routes usually follow the most direct paths to the various parts of the community. However, response corridors are often the more attractive routes for general traffic flow - a situation which sometimes results in traffic conjestion and delays in emergency response.

Primary response routes in Grover City include: Grand Avenue, Ramona Avenue, Eighth Street, Tenth Street, Railroad Drive, State Highway 1, Farroll Road, Brighton Avenue, and Newport Avenue, Fourth Street, North Twelfth Street, Thirteenth Street, Oak Park Blvd, Long Branch Avenue, and Mentone Avenue.

Evacuation routes as defined in Section VI, Emergency Preparedness, often adhere to major response corridors. Such is the case in Grover City.

8. Atascadero

a. Wildland Fire Hazards

Atascadero, an unincorporated community in north-central San Luis Obispo County, ranks as the County's second largest urban area. The community has developed primarily as a low density residential area with supporting commercial land uses and service facilities. Much of the residential development has occurred in the hilly portions of the area where flammable native brush and timber still remains. This trend has increased the threat of wildland (or "rangeland") fire, and has actually brought urban and wildland fire together as a common safety consideration. To illustrate the nature of this similarity, over 50% of the responses received by the Atascadero Fire Protection District involve rangeland fires.

Potentially, the most severe structural-wildland risk areas are north of Traffic Way, and east of U.S. Highway 101, and to a lesser extent, the area south of Pine Mountain and east of El Camino Real. Both of these locations are somewhat urbanized, and located near flammable vegetation.

b. Urban Fire Risks

(1) General Setting

The land use characteristics and the diversity of structural types make fire considerations more complicated than would normally be expected in an unincorporated setting. The community consists of a moderately-developed commercial core along Traffic Way and El Camino Real. The remaining flat areas have been developed as low density residences. Much low density hillside development has also occurred, the impacts of which are discussed in the previous discussion. Atascadero is also the site of the Atascadero State Hospital, a state-operated mental health facility.

The built-up nature and varied landscape of the Atascadero community necessitate the development of an effective fire fighting agency. Out of this need, the Atascadero Fire Protection District was formed, and has been delegated the responsibility for fire protection in the community. The Fire District operates from one station located on Lewis Drive in Atascadero. The District is staffed by both professional personnel and volunteers, and includes the following:

1 Professional Chief
2 Professional Captains
4 Professional Engineers
20 Volunteer Fire Fighters

The District's inventory of rolling fire response equipment includes the following:

2 1000 gpm Pumpers (structural use)
1 750 gpm Pumper (structural use)
2 Heavy 4-wheel-drive trucks (rangeland use)
1 Power Wagon (rangeland use)

The District's fire defenses are currently rated by the Insurance Services Office as Class 5 for the entire Atascadero Fire Protection District. Response to fire emergencies in the community requires a maximum of five minutes.

(2) Potential Hazards

Potential urban fire hazards in the Atascadero area relate primarily to (1) lack of basic fire safety consideration in the general layout and governing of the community, (2) the pipelines and electrical transmission lines that traverse the community and rangeland areas, (3) the presence of U.S. Highway 101 and the Southern Pacific Railroad, and (4) the access problems associated with operation from one fire station.

The major fire problem occurring in Atascadero is the lack of appropriate planning in the design and layout of the primary and secondary streets that serve the area. Existing street widths, especially when compounded by on-street parking, are inadequate in several locations for access by emergency equipment. In an emergency situation, valuable time would be lost in seeking alternative routes to the particular point of emergency.

A second problem associated with planning consideration concerns inadequate hydrant spacings in certain portions of the community. Many structures in the community are located on very large lots, and are often more than 500 feet from functioning fire hydrants. An effort to promote closer hydrant spacings in the design phase of future proposed projects should be considered to alleviate further extensions of the problems. Existing locations, particularly in the south end of the community and along the west-northwest perimeter of the community, are currently impacted by inadequate hydrant spacings.

As an unincorporated entity, Atascadero has no mechanism to promote or require weed abatement for the purposes of fire control. This results in the accumulation of plant material in vacant lots, and near existing structures, which raise the risks of fire to such areas. Incorporated Cities throughout the County have the capability to enforce such programs by requiring property owners to abate local weeds voluntarily, or pay for the service in the form of special tax levies. Weed abatement programs are usually effective in lowering structural losses during a fire situation.

The second set of potential fire hazards relate to the presence of pipelines and electrical lines in the area. The existence of infrastructure (oil pipelines, gas lines and electrical transmission lines, in particular) can increase an area's exposure to fire and explosion. Although facilities of these types are designed to withstand significant environmental disruptions, failures have been known to occur, resulting in pipeline rupture or transmission line collapse. Failures are most likely to be non-seismic in nature (see Section Iv C: Effects on Utilities). They are more likely to be caused by faulty pipes, accidental puncturing, or, in the case of power lines, high winds.

The third set of potential hazard consideration resemble those concerned with pipeline safety, and relate to the presence of U.S. Highway 101 and the Southern Pacific Railroad in the area.

The Southern Pacific Railroad and U.S. Highway 101 traverse the area in generally a north-south direction. The fire hazards associated with their presence relate to the flammable and caustic materials often transported in rail-mounted tank cars and trucks. No major disasters of this type have occurred to date, but the possibility of a future accident cannot be precluded. The Atascadero Fire Protection District, along with other local agencies, would be relied upon for any fire or chemical emergency such an accident might create.

The final hazard situation concerns those potential access problems associated with operation from a single station facility. Such stations run the risk of being isolated from potential emergencies if critical transportation links become jeopardized during periods of extreme environmental stress. A situation of this type is possible in Atascadero. The community is effectively bisected by Atascadero Creek, and access to each side is governed by the passability of bridges traversing the creek. Although most bridges crossing the creek are not susceptible to periodic floods, their performance has never been tested during a storm producing a flood of a 100-year frequency. Fire protection in smaller communities is often limited to a central facility which serves the entire community. Therefore, this

problem is commonly encountered.

(3) Response Corridors/Evacuation Routes

Response corridors are defined as primary routes along which emergency vehicles, including fire department equipment, travel when responding to a fire, or similar emergency. Response corridors are usually primary or secondary roads that offer sufficient width for fire vehicles. Roads chosen as response routes usually follow the most direct paths to the various parts of the community. However, response corridors are often the more attractive routes for general traffic flow: a situation which sometimes results in traffic conjestion and delays in emergency response.

Primary response routes in the community include: Traffic Way, California State Highway, Curbaril Avenue, Atascadero Road, and U.S. Highway 101. Evacuation routes as defined in Section VI, Emergency Preparedness, often adhere to major response corridors. Such is the case in Atascadero.

9. South Bay

a. Wildland Fire Hazards

The Southbay area does not face major wildland fire threats due to its environmental setting. Vegetation in the area is limited primarily to low growing grasses and scattered shrubs, the characteristic vegetation of disturbed Northcoastal Grasslands. Another fire-limiting characteristic of this area is the cool, marine-influenced climate. Temperature extremes do not occur very often, nor does the relative humidity decline to critically-low, fire hazardous levels.

b. Urban Fire Risks

(1) General Setting

The Southbay (Los Osos) area is an unincorporated, primarily residential area that has undergone rapid growth in recent years. During the period 1970-1974 Southbay has increased in population from 3487 residents to 6589. Housing units have nearly doubled during this period, and now number approximately 2786.

The development of Southbay into a low density residential area necessitated the formation of the Southbay Fire Department, the local agency responsible for fire protection in the community.

The Southbay Fire Department operates from one facility located on Baywood Heights Drive, and is staffed by both professional personnel and volunteers, including the following:

6 Salaried officers
4 Part-time officers and firefighters
12 Volunteer fire fighters

The Fire Department's inventory of rolling fire response equipment includes the following:

1 1250 gpm Pumper
1 750 gpm Pumper
1 Ambulance

The Department's fire defenses are currently rated by the Insurance Services Office as Class 7 for the developed portions of the community and Class 9 for those areas beyond present developments. The Southbay department responds to approximately 75 alarms in a year, 50% of which are structural in nature. Responses to emergencies in the Southbay community require approximately four minutes.

(2) Potential Hazards

Potential fire related hazards in the Southbay area are linked closely with the area's growth. Essentially, the community's fire protective capabilities have not kept pace with the large increase in housing units and population that has occurred in the last four years. Street access and water supplies that were once adequate are no longer so. This problem is difficult to localize

in a given area, however, it has been most keenly felt in the vicinity of Santa Ysabel Road.

Another potential hazard arises from the large number of empty lots overgrown with weeds and accumulated debris. As an unincorporated entity, Southbay has no mechanism to promote or require weed abatement for the purposes of fire control. This results in the accumulation of plant material in vacant lots, and near existing structures, which raise the risks of fire to such areas. Incorporated cities throughout the County have the capability to enforce such programs by requiring property owners to abate local weeds voluntarily, or paying for the service in the form of special tax levies. Weed abatement programs are usually effective in lower structural losses during a fire situation.

The final hazard situation concerns those potential access problems associated with operation from a single station facility. Such stations run the risk of being isolated from potential emergencies if critical transportation links become jeopardized during periods of extreme environmental stress, or traffic congestion. Although the community is not divided by a major stream, heavy flooding could conceivably render key response routes useless, thereby necessitating detours in an emergency situation. Such detours would require extra response time, a factor critical during a fire or similar emergency.

(3) Response Corridors/Evacuation Routes

Response corridors are defined as primary routes along which emergency vehicles, including fire department equipment travel when responding to a fire, or similar emergency. Response corridors are usually primary or secondary roads that offer sufficient width for fire vehicles. Roads chosen as response routes usually follow the most direct paths to the various parts of the community. However, response corridors are often the more attractive routes for general traffic flow: a situation which sometimes results in traffic congestion and delays in emergency response.

Primary response routes in the community include: Santa Ysabel Avenue, El Morro Avenue, Seventh Street, Ramona Avenue, Ninth Street and Los Osos Valley Road. Evacuation routes as defined in Section VI, Emergency Preparedness often adhere to major response corridors. Such is the case in Southbay.

10. Cayucos, Cambria, Nipomo, Oceano

Introduction

The communities of Cayucos, Cambria, Nipomo and Oceano share several basic characteristics with respect to fire hazards analysis. All three areas are unincorporated urban areas in San Luis Obispo County, and are primarily residential in nature. Each community is served by volunteer fire departments that are somewhat limited in overall fire response capabilities. In view of these basic similarities they will be treated jointly. However, significant or unique characteristics will be discussed relative to each location.

a. Wildland Fire Hazards

Wildland fire hazards in the communities of Cayucos, Nipomo, and Oceano are not a major concern due to their environmental setting. In these locations, the naturally-occurring vegetation is limited primarily to low-growing grasses and shrubs that are characteristic of disturbed Northcoastal Grasslands, or it has been displaced by

urban uses and agriculture.

On the other hand, fires involving native vegetation play a more significant role in the Cambria area. Cambria is located in the mountainous area of the westernmost Santa Lucia Mountains. Vegetation in the area falls within the Evergreen Forest Classification, and is characterized by the presence of large oaks, of various species, laurel, madrone, and Monterey Pine. Trees in this plant community often attain considerable height, and can interfere with electrical transmission lines. A significant number of fires in Cambria originate when tree limbs fall upon electrical lines during periods of winds and stormy conditions.

b. Urban Fire Hazards

(1) General Statement

Each community has been developed primarily as a low density residential area, with some supportive commercial enterprises, and little or no industrial concerns. Populations range from 2037 in Cayucos to 4683 in Nipomo.

The lack of intense, or particularly hazardous land uses simplifies the urban fire situation in each area. The fire protection need that does exist is currently provided either by a small voluntary force in each community, or through a contract with an agency such as the California Division of Forestry. A listing of fire protective capabilities, and Insurance Services Office classification is contained in the following table:

Table 8
Fire Protective Resources
Cayucos, Cambria, Oceano, Nipomo

Community	Voluntary Personnel	Equipment	ISO Ranking
Cayucos	13	(1) 500 gpm pumper (1) 200 gpm pumper	8
Cambria	20	(1) 750 gpm pumper (1) 700 gpm pumper	9
Oceano	20	(2) 750 gpm pumpers	7/9
Nipomo	2 paid personnel provided through CDF	(1) 750 gpm pumper	unranked

(2) Potential Hazards

The communities of Cayucos, Cambria, Oceano and Nipomo do not possess the built-up areas or hazardous land uses that normally create complicated fire defense situations. Each community, in general, has responded to these situation by providing a minimum level of structural fire protection. The potential hazards that exist in each area relate to the level of protection that has been provided. For most emergencies in the communities the existing protection would probably prove to be only marginally effective or ineffective depending on the type and severity of the emergency.

Providing additional fire protection in a community requires expenditures of relatively large sums of money. Added taxes and special district levees would be partially offset by lowered insurance rates, but the net effect would be an increase in cost to the business operator and property owner in the community. Presently, the population does not seem to be willing to accept these added costs, and is willing to function within the existing level of protection.

Fire protection could be improved in the various communities by providing more equipment, increasing water supplies and adding paid, full-time positions to the local department. Solely from the standpoint of fire prevention, such moves seem warranted. However, the economic base of the areas doesn't seem able to absorb added levees to finance a more efficient fire department. The solution, therefore, is to either accept existing levels of protection or change the method by which local fire protection is organized and financed.

Several methods exist which, if implemented, would result in a reorganization that could possibly increase protection at a net savings. A more detailed discussion of these procedures will be included in the Policy Section of the Public Safety Element.

3. Response Corridors/Evacuation Routes

Response corridors are defined as primary routes along which emergency vehicles, including fire department equipment travel when responding to a fire, or similar emergency. Response corridors are usually primary or secondary roads that offer sufficient width for fire vehicles. Roads chosen as response routes usually follow the most direct paths to the various parts of the community. However, response corridors are often the more attractive routes for general traffic flow: a situation which sometimes results in traffic congestion and delays in emergency response.

Major response routes in each community are as follows:

Cayucos

State Highway One, C Street, Ash Street, and Ocean Boulevard

Cambria

State Highway One, Ardath Drive, Pineridge Road, and Windsor Boulevard

Nipomo

Thompson Avenue, Teffet Road, and Orchard Road

Oceano

State Highway One, Paso Robles Street, The Pike, Wilmar Avenue, and 22nd Street.

III. FLOOD HAZARDS ANALYSIS

A. Introduction

The purpose of this report is to describe the potential for flooding and dam inundation in the County of San Luis Obispo and relate these findings to planning considerations. The evaluation of flood hazards is, by its nature, an approximating process that can be influenced by several factors. In general, the areal extent of flood hazards is delineated on the basis of estimated severity of major storms and the performance of existing channels, either natural or man-made. The mapped portions of this study represent only approximated limits of flooding potential, and are based upon currently available data derived from County, State, and Federal sources.

B. General Conditions

San Luis Obispo County is a large intra-state jurisdiction that comprises over 3,500 square miles of varying terrain in Central California. It stretches from the San Joaquin Valley on the east to the Pacific Ocean on its west boundary. Included within the boundaries of San Luis Obispo County are a wide variety of climatic, topographic, and land-use factors that make the aspects of flooding quite diverse throughout the County.

The quality of life enjoyed by the residents along with the productivity of agriculture, the County's largest industry, is closely linked to the availability of water. However, the positive aspects inherent in its availability can become a serious liability during a flooding situation. To protect certain low-lying areas prone to periodic flooding, protective measures including dams, levees, and enlarged channel ways, have been constructed to help minimize the risks to life and property. The adequacy of these facilities is dependent upon the capacity to which they were designed, relative to the site of flood being considered, as well as the growth that has taken place in adjacent areas. Growth, or more precisely, the changes in surface permeabilities and slopes can significantly alter the hydrology of an area.

For the purposes of this report, the flooding associated with the 100-year storm will be of primary consideration. Such a storm has statistical likelihood of occurring once in a hundred year time span, or a 1% chance of occurring in any given year. The 100-year flood can occur in any year or even more than once during a year, though such an event is not "likely."

The 100-year flood determination is becoming an accepted standard for flood protection by agencies involved in the assessment of flood risks. The Department of Housing and Urban Development (HUD), in their issuance of flood insurance as part of the Flood Protection Disaster Act of 1974, has adopted the 100-year flood level as the determinant of the flood plain area having a hazard potential requiring specified controls or protective measures. The relationships of the Flood Protection Act of 1973 to this study, as well as local planning, will be discussed at the conclusion of this report.

C. Climate

The climate of San Luis Obispo County resembles most of Southern California, with its relatively short rainy season and drought-dominated periods extending from late Spring through Autumn. More precisely, the climate of the County is Mediterranean. This type of climate is characterized by three features: 1) rainfall of moderate amounts concentrated in the winter seasons with summers being nearly or completely dry; 2) warm to hot summers and very mild winters; and 3) a high percentage of sunshine throughout the year, particularly during summer. Snowfall as a factor in the Mediterranean climate is of little significance in that it is entirely absent from the valley floor, and is generally light in the mountain areas except at extreme altitudes.

The mean annual precipitation in San Luis Obispo County varies, depending upon relative position of surrounding topographic features. County-wide, precipitation varies

from a low of approximately 5 inches per year in the Temblor Range and the Cuyama Valley to means of 30 inches per year in the Santa Lucia Mountains.

The table below presents the 32-year mean seasonal precipitation for regions within San Luis Obispo County. The values are based upon precipitation records for several stations within each region kept over the past 30-50 years.

Table 9
Mean Seasonal Precipitation

Location	Years of Record	32-Year Mean
San Luis Obispo (Poly)	102	21.68
Paso Robles	84	14.78
Atascadero (Mutual Water Co.)	54	17.49
Templeton	46	19.19
Shandon (Union Oil Company)	39	9.62
Avila Beach (Union Oil Company)	40	16.78
Santa Margarita (Union Oil Company)	32	20.39
Hearst Ranch (San Simeon)	35	25.59
Simmler (State Division of Hwys)	35	8.52
Cambria (State Division of Hwys)	31	18.90
Arroyo Grande (Police Department)	33	15.60
Los Osos (Bender)	18	18.13
Nipomo (State Division of Forestry)	13	13.44
Oceano (C.S.A. #13)	13	13.11
Baywood Park (C.S.A. #9)	6	16.00
Whale Rock Reservoir (Cottontail Creek)	3	--

Based on the preceding table, it appears the higher elevation areas in the County absorb most of the rainfall, and thus, are exposed to greater risk of flooding. That observation, however, ignores the concept of watershed, an element critical in determining the likelihood and extent of flooding. The precipitation that falls in the upper elevations of a watershed collects and is conveyed through streams and river systems to the sea or to low-lying lakes and groundwater basins. The accumulation of water that occurs in the lower elevation areas of the County creates the most damaging episodes of widespread flooding.

D. Streams

The major streams in the County, both from the standpoint of average flows, and flooding potential, include the Salinas River, Santa Maria-Cuyuma River System, Nacimiento River, San Luis Obispo Creek, Arroyo Grande Creek, Morro Creek, and Huer Huero Creek. All of these river systems include numerous smaller tributaries that contribute to the overall drainage in the County. Each river system demonstrates a different set of physical characteristics

and land-use patterns that influence the flooding potential.

The Salinas River originates in the high country of the Santa Lucia Mountains near the community of Santa Margarita. It drains over 500 square miles of San Luis Obispo County before exiting the County near San Miguel, the County's major streamcourse. The river also creates the most extensive floodplain in terms of acreages inundated, however, much of the resultant floodplain is contained within the fairly well-defined stream bed.

The Santa Maria-Cuyama River System is another major drainage network in the central coastal area. The river system originates in the Los Padres National Forest area in Ventura County, and flows in a generally westward direction, emptying into the sea near Santa Maria. Together, the two rivers define the south boundary of San Luis Obispo County. The floodplain associated with the system varies greatly in width, sometimes exceeding one mile. However, much like the Salinas River, the Santa Maria-Cuyama River System floods mostly those areas lying within the well defined floodplain.

The Nacimiento River drains approximately 350 square miles of northern San Luis Obispo County, and is one of the major tributaries to the Salinas River. Much of the river has been obliterated by Nacimiento Reservoir built in 1957. The "buffering" capacity created by the construction of the dam has mitigated much of the downstream flood potential associated with the river.

San Luis Obispo Creek originates in the western slopes of the western slopes of the Santa Lucia Range, at an elevation of approximately 2,200. The Creek flows generally in a southwest direction through the City of San Luis Obispo, and is joined by its major tributary, Stenner Creek, in the west portion of downtown San Luis Obispo. The total drainage area for the entire creek basin is approximately 83 sq. miles, an area which may seem less significant than the other rivers and drainage basins previously discussed. However, the hydrology of the San Luis Obispo Creek basin and the land use adjacent to the creek in the City combine to form a significant flood hazard. This particular drainage system has been the subject of extensive analysis, including a 1974 report published by the U.S. Army Corps of Engineers.

Arroyo Grande Creek drains approximately 120 square miles of southwestern San Luis Obispo County. It originates in the southerly portion of the Santa Lucia Range, and drains generally southwestward, through the City of Arroyo Grande. The flood potential of Arroyo Grande Creek has largely been mitigated by the construction of Lake Lopez Dam.

Morro Creek originates in the Cerro Alto area of the Santa Lucia Mountains, and drains in a westward direction, eventually emptying into Morro Bay. Morro Creek drains approximately 24 square miles, and essentially bisects the City of Morro Bay. Most flooding in the Morro Bay area is associated with this particular stream.

Huer Huero Creek drains approximately 150 square miles of generally flat terrain in the Paso Robles area. Most major flooding in the vicinity of Paso Robles is caused by this drainage, and the Salinas River drainage.

E. Historic Floods

San Luis Obispo County has been damaged by severe, widespread flooding numerous times during its history. Early records indicate that flooding destroyed homesteads and livestock and polluted local wells. The loss of life and property to flooding disasters mounted as more people moved into the area, building homes and other capital investments either in, or adjacent to, the flood plain. The escalating dollar costs of flooding were clearly illustrated during the 1969 flood. When property damages totaled approximately $5,000,000. Economic vulnerabilities continue to increase as the County grows in both population and overall worth.

1. January-February, 1969

The floods of January-February, 1969, were the most damaging floods of record in San Luis Obispo County. On January 14 a three day storm began which produced approximately 2 inches of rain in the San Luis Obispo area. That storm, though considered a sizeable event, produced no flooding problems because rainfall intensities were low and a large percentage of the precipitation penetrated the soil. Three days subsequent, a series of warm rains moved in from the southwest. This began an eight-day period of nearly continuous medium and high intensity rainfall which totaled 12.01 inches in Paso Robles and 21.80 inches in San Luis Obispo.

Rainfall essentially ceased for the first half of February, allowing for some relief and recovery from the damages of the January flood. However, another storm struck the area the evening of February 21 and continued with little abatement for six days, depositing an additional 5.6 inches of rainfall in the Paso Robles area and 9.5 inches in the vicinity of San Luis Obispo.

The 1969 floods created serious hardships for residents throughout the County. The U.S. Army Corps of Engineers, in their publication "Report on Floods of January and February, 1969 in Southern California" offer this account of the damages caused by the two high water episodes:

"The most severe damages to urban property occurred in the City of San Luis Obispo, where the San Luis Obispo Creek channel became clogged with debris and flow in the channel overtopped the channel banks and moved down the main streets of the city. Massive mobilization efforts during and after the January flood by the City of San Luis Obispo and the Corps of Engineers prevented additional damages to urban property during the February flood. Severe damages were sustained by streets, highways, and utilities throughout the County. The water-supply system of Cambria was damaged in the floods and large parts of the town were without electricity; residents were advised to drink only boiled water because of the possibility that the local water supply might be contaminated. The destruction and damge of sewerlines and sewage-treatment plants at many locations posed a threat to the lives and health of many residents. The sewage-treatment plants at Morro Bay, Avila Beach, and Pismo Beach were inundated by both floods. Debris and raw sewage piled up on the beaches and carried in the streams posed serious threats to health until emergency cleanup operations were completed."

A detailed summary of the flood damages from the January and February 1969 flood also appeared in the previously described U.S. Corps of Engineers report, and is included here:

Table 10
Flood Damage Summary, 1969
San Luis Obispo County

Residential	$ 289,000	$ 8,600	$ 297,600
Business and industrial (including vehicles)	826,500	33,700	860,200
Agricultural	594,600	119,100	713,700
Highways and bridges	1,047,600	28,500	1,076,100
Utilities	315,100	103,800	418,900
Public	308,600	105,000	413,600
Flood-control, irrigation, and water-reclamation facilities	---	---	---
Railroad	---	---	---
Beaches, parks, recreational facilities, harbors	*	*	
Land (undeveloped)	---	---	---
Military (Vandenburg Air Force Base)	---	---	---
Stream channels requiring clearing and restoration	767,400	451,100	1,218,500
Total	$4,148,000	$849,800	$4,998,600

*Included in damages to public property

2. January, 1973

The flood of January, 1973 was the most devastating flood ever recorded for the San Luis Obispo Creek drainage area. Much like the floods of 1969, the 1973 disaster was of the general winter type, producing a ten-hour period of unusually heavy rainfall. San Luis Obispo Creek, and its tributary, Stenner Creek, overtopped their banks and inundated wide areas of downtown San Luis Obispo. Damage figures exceeded the 1.5 million dollar level that was incurred during the flood disaster of 1969.

F. Existing Flood Hazards

Flooding can create several types and levels of hazards to residents in an area. The most direct threat relates to the hazard to human life created by the sheer force and volume of water that can accompany periods of heavy runoff. In general, a flood depth of 3 feet and a velocity of 3 feet per second is considered a major threat to human safety.

A second level of hazard is concerned with the effects of flood waters on property. Most dollar losses associated with flooding are incurred through damage to both public and private structures and improvements.

A third level of hazard associated with flooding is impairment of response capabilities by emergency personnel and of communication-transportation networks necessary during an environmental disaster such as a major flood. Bridges that traverse flood prone streams are a major concern. By obstructing downstream flows, bridges create a damming effect on large volumes of floodwaters. These floodwaters can, in turn, exert significant amounts of hydrostatic stress on the bridge supports in direct contact with the surging floodwaters. Stresses of this type can occasionally be of sufficient magnitude to cause structural damage or total failure of a bridge facility. Bridges across key routes become even more critical during emergencies such as major floods. An important response route rendered unusable by heavy runoff could seriously jeopardize an agency's ability to respond in the most efficient manner.

100-year flood plains described in the following pages appear on the Natural Hazards Maps prepared for each City and unincorporated planning area in the County. All maps and flood-related conclusions were developed from existing information for Federal, State, and County sources. These delineations indicate only the general extent of flood plains and are not adequate for specific hazard lands administration purposes such as site-planning, zoning application or building regulations enforcement. Precise mapping based on engineering surveys by qualified personnel will be necessary to definitively fix the boundaries of the 100-year floodplain.

1. City of San Luis Obispo

The City of San Luis Obispo would be exposed to major flooding in the event of a 100-year flood. Flooding would occur throughout the length of San Luis Obispo Creek and its major tributary, Stenner Creek, Brizziolari Creek and Prefumo Creek. Studies compiled by the U.S. Army Corps of Engineers indicate the resultant floodplan would be particularly wide in the areas of Santa Rosa Street, and Broad Street, as well as Prado Road and Laguna Lake to the south.

The floodplain in the San Luis Obispo area has been influenced by surrounding land use changes. The area's development has resulted in increased runoff in the area, and the emplacement of flow obstructions (bridges and culverts) across the streams in the area. Information generated by the Corps of Engineers indicates that several of these obstructions would be submerged in a flood of a 100-year magnitude. The following table, taken from the 1974 Corps of Engineers Flood Plain Information report for San Luis Obispo Creek lists these various obstructions, as well as estimated flood elevations in each respective location:

Table 11
Elevation Data for 100-year
Flood Along San Luis Obispo Creek
and Tributaries

Identification	Low Chord Elevation	100-Year Flood Elevation
SAN LUIS OBISPO CREEK:		
Harford-Avila Rd.	22.0	10.2
San Luis Bay Dr.	28.7	20.6
Ontario Road	31.0	27.7
U.S. 101	33.0	31.4
San Luis Bay Dr.	37.0	41.5
Abandoned Farm Rd.	34.9	43.6
Private Road	45.0	48.9
Private Road	63.0	67.7
Private Road	65.0	71.0
SAN LUIS OBISPO CREEK:		
South Higuera St.	80.0	85.3
Abandoned Hwy.	86.8	90.7
Prado Road	133.0	133.0
Elks Lane	142.0	145.0
Madonna Road	159.0	155.1
Bianci Lane	163.5	169.2
Marsh St.	167.0	175.5
Nipomo St.	187.3	192.5
Broad St.	195.9	192.9
Wood Footbridge	193.9	193.0
Concrete Footbridge	201.8	196.0
Undercity Culvert Outlet	202.0	202.0
Undercity Culvert Inlet	212.0	218.8
Marsh St.	216.5	218.8
Santa Rosa Street	219.7	224.0
Toro Street	226.0	231.0
Johnson AVenue	235.6	234.2
S.P.R.R.	249.0	241.2
California Blvd.	249.5	253.0
Andrews St.	272.7	276.0
U.S. 101	306.4	318.8
STENNER CREEK:		
Nipomo St.	180.7	187.5
U.S. 101	183.3	199.1
Broad St.	194.1	199.1
Chorro St.	191.9	199.1
Santa Rosa St.	226.0	230.5
Murray St.	231.3	235.2
Foothill Blvd.	242.6	254.9
Cal Poly Access Rd.	270.8	279.0
West Mt. Bishop Rd.	313.6	312.0
Stenner Rd.	319.0	320.4
PERFUMO CREEK:		
U.S. 101	102.0	107.0
U.S. 101 offramp	103.7	109.8
Calle Joaquin	105.6	109.9
Madonna Road	124.9	126.0

Identification	Low Chord Elevation	100-year Flood Elevation
BRIZZIOLARI CREEK:		
Agricultural Rd.	285.0	283.2
S.P.R.R.	294.8	285.5
N. Perimeter Rd.	281.8	286.0
Unnamed Culvert	290.1	294.0
Campus Footbridge	303.5	307.1
Campus Way	306.0	308.4
Unnamed Culvert	314.7	319.0
Unnamed Culvert	328.5	335.8

2. City of Morro Bay

Flooding in the City of Morro Bay during a 100-year storm would probably occur along Morro Creek and Little Morro Creek. The flooding itself would be primarily limited to the creek area, and would not extend into areas away from the defined stream bed. A potential hazard could develop, however, if high water volumes rendered the State Highway 1 bridge unusable. This facility is critical to emergency response in the northern part of the City. Unnamed Creek is also a source of potential flooding. Flood waters from Unnamed Creek have potential for overflowing the stream bed and blocking passage on North Main Street.

3. City of El Paso de Robles

The City of El Paso de Robles would be affected most by flooding along the Salinas River. A 100-year flood on the Salinas River would separate the eastern part of the City from the main western portion. While fire protection is provided on both sides of the River, water and sewer services could be impaired on the east side in the event of a major flood. Other flood prone areas exist along Mustard Creek Road, 12th Street, Pacific Avenue, 4th Street, and Paso Robles Bouelvard.

Response efforts could be affected by estimated flood heights in the City.

4. City of Pismo Beach

Flooding in the Pismo Beach area occurs primarily in the low-lying areas to the east of the City. Much of this area is comprised by Pismo Marsh, and thereby does not constitute a major threat. A potential hazard could result, however, if the City's sewage disposal plant was damaged by flooding. A similar event occurred during the 1969 flood, and created a substantial secondary health hazard.

5. City of Arroyo Grande

Flooding in the City of Arroyo Grande is confined to the Arroyo Grande Creek area and does not constitute a major hazard. However, flooding at 100-year levels could hinder response efforts if certain routes and key bridges were rendered unusable by high water levels.

6. Grover City

Flooding in the Grover City area is confined to the beach area, and a well-defined corridor south of U.S. Highway 101, and does not present a significant hazard.

7. Atascadero

The community of Atascadero is located adjacent to the Salinas River, and is exposed to a minimal level of flood hazard from heavy runoff along that stream. Since most flooding would be restricted to the defined river area, existing hazards relate more to potential access and response difficulties during high water periods.

8. South Bay

The community of South Bay is confronted with no major flood-related hazards.

9. Cayucos

Since flooding in the Cayucos area is confined to the streams and washes of the area, the area faces no major flooding hazards.

10. Cambria

100-year flooding in the Cambria area is confined to the Santa Rosa Creek, thereby eliminating major flooding problems associated with overland flow. However, even restricted flooding in the community could significantly hinder emergency response efforts.

11. Nipomo

Flooding in the community of Nipomo occurs primarily along Nipomo Creek, Deleissiques Creek, and an unnamed creek system flowing basically in the alignment of Tefft Street. Anticipated overland flows are fairly well restricted to the creek areas; and the remaining potential hazards are primarily related to street access and bridge adequacy in the area.

12. Oceano

The community of Oceano is not confronted with major flood hazards.

G. Hazards From Dam Failure

Section 8589.5 of the Government Code, which became law in 1973, requires all dam owners to submit to the State Office of Emergency Services (OES), maps showing areas that would be inundated given an instantaneous collapse of their respective dams. Large dams are categorized with nuclear reactors, power intertie systems, and plants manufacturing explosives as structures whose continued functioning is critical, or whose failure might be catastrophic. Although this type of catastrope is highly unlikely, the nature of the hazard is such that it should be considered.

The collapse of a dam, an event of unforeseen severity, would create an inundation several magnitudes greater in area than a flood caused by heavy rains. Records from the 1928 failure of the St. Francis Dam in Los Angeles County (capacity 32,000 acre-feet) describe a flood flow of 500,000 cubic feet per second, and a "wall" of water over 100 feet high in the confining canyon (Report of Commission 1928). It should be stressed, however, that none of the dams affecting the study area should fail, based upon current evidence.

Pertinent characteristics of the large dams and reservoirs in the study area are summarized as follows:

Name	Owner	Capacity (acre-feet)	Type of Facility
Atascadero*	S.L.O. County	250	Earth
Eagle Ranch	Helen Smith	300	Earth
Hartzell	W.W. Hartzell	300	Earth-rock
Las Tablas Creek	Paul R. Hackstedde	180	Earth
Lopez*	S.L.O. County Flood Control	51,000	Earth
Nacimiento*	Monterey County Flood Control	350,000	Earth
Righetti*	Ernest Righetti	564	Earth
Salinas Dam*	Corps of Engineers	26,000	Variable Arch
San Marcos	H.E. Blythe	325	Earth
Terminal*	S.L.O. County Flood Control	844	Earth
Twitchell*	Bureau of Reclamation	240,000	Earth
Whale Rock*	State Department of Finance	40,000	Earth

*Inundation map available

Of the dams listed in the preceeding table, Whale Rock Reservoir, Righetti Reservoir and Lopez Reservoir have the greatest hazard potential in the County. The inundation maps for the remaining dams indicate (1) no appreciable flow beyond existing stream boundaries, (2) flooding in areas away from human settlement, or (3) flooding in areas outside San Luis Obispo County.

Whale Rock Reservoir, with a capacity of 40,000 acre-feet, is located in the hills above the community of Cayucos. The level of damage in Cayucos to be anticipated given the complete failure of Whale Rock Reservoir at full capacity would be enormous. Approximately 15 minutes would be required for the initial flood wave to reach the sea, and, in that time, approximately one-third of Cayucos would be essentially destroyed. When compared to a natural flood, the time of the actual disaster would be brief. The velocity of flow during this time and sheer volume of the inundation wave would cause significant levels of destruction.

An inundation of Lopez Reservoir at maximum volume (51,000 acre-feet) would cause widespread inundation in the Arroyo Grande Valley area. Since the developed areas of the Valley are located primarily on flat plain drained by Arroyo Grande Creek, the inundation of these areas is expected to be slow. This relatively slow raising of the water level would help mitigate much of the impact of dam failure because it would allow for evacuation and temporary damming of exposed property.

Righetti Reservoir is a privately-owned facility with a capacity of approximately 564 acre-feet. Given a complete failure at full capacity, an inundation wave, ranging in width from 200 feet to 1000 feet would closely parallel Corral de Piedra Creek. Such an inundation would have neither the volume nor the destructive force which can be expected in the event of dam failures at either Whale Rock Reservoir or Lopez Reservoir.

Since few inundation disasters have occurred in recent times, the ability of structures to withstand the expected sources of a flood surge is not well understood. Current procedures for human safety define evacuation, as was seen during the Van Norman Dam experience, as the only safe solution when the threat of inundation is imminent. Dam failures and subsequent inundations should be considered as events that can occur, but are very unlikely to occur. Studies concerned with the potential impacts of failure, including those referenced in this analysis, are evacuation tools to be used during the implementation of Civil Defense procedures. No assumptions or conclusions regarding dam safety are contained in such studies.

H. Relationships Between Local Planning and Federal Flood Insurance

San Luis Obispo County has experienced severe episodes of widespread flooding many times throughout its history. Past floods have cost the lives of many individuals, as well as dollar losses that amount to many millions of dollars. Like much of the nation, San Luis Obispo County faces an ever-increasing potential economic loss due to flooding.

Early man did not face as great a peril to occasional flooding as does his modern successor. Village remains, in many cases, indicate he respected the river for both its life-giving water, and its power, and seldom were their villages inundated by onrushing flood waters.

However, in the centuries of development since those early times, man's relationship with local streams has changed. Pressures to grow and expand have made the floodplains very attractive for development. Man found that by building in the flat floodplains he could do so cheaply. He also found that needed water could be found by tapping aquifers lying below the floodplains. Thus, the floodplains and areas near them became the focal points for developments of the cities, towns, and agricultural centers that exist today.

Early recognition of the hazards associated with flooding brought efforts to minimize the danger. Since floods were caused by rivers and creeks, the first apparent solution involved controlling the rivers themselves.

Dikes, levees and dams, made possible by grants, bonds and other capital outlays insulated several areas from flood hazards.

However, the expense of flood-control facilities make complete protection of areas such as San Luis Obispo County a very costly proposition. The Federal Government, alarmed by rising damage claims due to flooding, initiated another approach to flood control with the passage of the Flood Disaster Protection Act of 1973. That act proposed another technique of flood protection. Instead of "keeping the flood from the people" the intent of the measure sought to "keep the people from the flood." By relying on the existing financial regulating capabilities of Federal Government, the administering agency, namely the Department of Housing and Urban Development (HUD), stated that no federally-related or federally-insured funds would be available for new construction in areas designated "special flood hazards", unless specified flood-proofing measures were applied. The Act also allowed existing structures located in designated flood hazard areas to be insured for flood damages at a subsidized rate.

Communities were given until July 1, 1975 to participate in the Federal program. On that date, the prohibition on federal financial assistance became effective. Prior to that date, it was necessary for HUD to catalog those areas in the country exhibiting the potential for flooding. A massive effort was begun in 1973 and by the deadline, most incorporated areas in the Country were mapped on a preliminary basis. Included among them were all Cities and communities in the County of San Luis Obispo.

IV. GEOLOGIC HAZARDS ANALYSIS

A. General Statement

Geologic and seismic hazards have been analyzed for the County generally and for each of the Cities in the County as a part of the Seismic Safety Element for each of these jurisdictions. To avoid unnecessary duplication, the major conclusion of these analyses are summarized below for the County, and for those Cities or groupings of Cities that have adopted elements. Summaries for unincorporated areas such as Cambria and Nipomo are extracted from data developed for the County Seismic Safety Element. In addition to the major conclusions regarding geological hazards, the interactions of these hazards with certain major types of facilities such as dams and utilities are discussed in succeeding sections.

B. Geologic Hazards

1. San Luis Obispo County

Specific conclusions regarding seismic and geologic hazards from the Seismic Safety Element of the County are summarized below. References are to the Plates and Tables included in that Element.

Active Faulting

The states of activity of the major faults in the County have been evaluated using available detailed mapping supplemented by local field examinations and aerial photo study. The evaluation has been made in the context of definitions and procedures established for the Alquist-Priolo Act.

The San Andreas fault is active, and is expected to be the source of a magnitude 8.0-8.5 earthquake in the near future. This earthquake would be accompanied by 20-30 feet of ground displacement.

The Nacimiento fault is seismically active. Data is inadequate to determine the potential for future ground rupture.

The Riconada fault is seismically active, but probably not the site of ground rupture in the near future. Data is inconclusive on the latter point, and additional studies would be advisable.

The Offshore fault is seismically active, but available marine geophysical data indicate future surface rupture is very improbable.

The San Juan, La Panza, East Huasna, West Huasna, Edna, Indian Knob, San Miguelito, and Edna extended (?) faults are probably inactive.

Ground Shaking

The primary source of strong ground shaking in the County is expected to be the San Andreas fault. An earthquake of Richter magnitude 8.0 to 8.5 is expected in the near future.

The Nacimiento fault is considered a secondary source of strong shaking that could modify the zonation in the northwestern part of the County. Available data indicate a very long recurrence interval (1400 years) for this event, but the occurrence of a magnitude 6.0 event in the instrumental record suggests an earthquake of this magnitude should be considered.

Shaking from earthquakes expected on the Rinconada and Offshore faults would not significantly modify the severity of shaking expected from the San Andreas fault.

Based on the San Andreas and Nacimiento faults as sources of shaking, the County is divided into 4 zones based on distance to the causative fault, within which 5 basic rock and soil conditions may be present. The combination of these two controlling parameters results in a maximum of 20 zones based on both distance and rock type.

The general characteristics of ground shaking in each zone and the reference to the response spectra are given in Table 15 of the Element.

Secondary Hazards

Areas susceptible to damaging rates of settlement identified in the course of the investigation are limited primarily to recently deposited alluvium as in the channels of active streams and some bay or ponded mud deposits as at Morro Bay or Lake Laguna. These areas are generally unsuitable for construction in their natural state because of hazards other than seismic (e.g. flooding), and considerable modification would be required before occupancy would be safe.

An unusual area of rising ground is present near Edna. Preliminary work by the California Division of Mines and Geology indicates that settlement is not involved, but the nature of the rising ground is as yet unknown.

The evaluation of liquefaction potential in a deposit requires detailed information on the engineering properties of the material as well as the shaking characteristics of the earthquake. The latter are included herein for use by the soils engineer in evaluating the liquefaction potential of a site utilizing the detailed engineering data acquired during the site investigation.

A generalized guide to the liquefaction potential of certain materials is as follows:

Material	Liquefaction Potential	Units on Plates 1A & 2A
Rock	Very Low	a, b, c,
Terrace deposits, etc.	Low to Moderate	d
Recent alluvium	Moderate to High	e, x, (in part)

Landslide risk categories are delineated on Plate 2A for the coastal portion of the County, and on Plate 1A for the central and eastern parts. The categories are based on empirical relationships between landslides known in areas of detailed mapping and controlling parameters such as rock materials, rainfall and slope.

Tsunamis and Seiches

Records of tsunamis along the County's coastline in the past indicate that those to be expected in the future should not exceed the tidal range. A hazard would exist if a tsuanami and high tide should occur in phase.

True seismic seiches are not considered as constituting a significant hazard in San Luis Obispo County.

2. City of San Luis Obispo

Conclusions regarding seismic and geologic hazards are summarized from the Seismic Safety Element of the City of San Luis Obispo as follows:

Active Faulting

No active or potentially active faults, as defined by the State Geologist and the State Mining and Geology Board, are known to be present in, or in the near vicinity of, the City.

Ground Shaking

The primary source of strong ground shaking in the City is expected to be the San Andreas fault. An earthquake of Richter magnitude 8.0 to 8.5 is expected in the near future.

Shaking from earthquakes expected on the Rinconada and Offshore faults would not significantly modify the severity of shaking expected from the San Andreas fault.

The City is located in Zone 1 of the County Seismic Safety Element. The characteristics of expected shaking for six microzones, based on variations in rock/soil type, are summarized in Table 1 and Figures 1 through 3 of the Element.

Secondary Hazards

Areas subject to liquefaction are rated as high+ in areas of well stratified lake deposits (Zone R_L), with a high water table; as high in poorly consolidated alluvial deposits (Zone R) where limited groundwater data suggests levels less than 30 feet below the surface; and as low to moderate in terrace deposits and the Paso Robles Formation (Zones P and Q). Rock materials (Zones F, K, and T) are considered to have a very low to essentially non-existent potential for liquefaction. These zones are delineated on the Seismic Zones Map accompanying the Element.

Liquefaction is not expected to be widespread, but may occur locally, particularly in Zones R and R_L. Detailed soils engineering and geologic investigations will be necessary to further evaluate the potential for liquefaction, and to further define affected areas.

No areas of expected significant settlement have been identified outside of areas identified as potentially subject to liquefaction.

The appraisal of slope stability has identified five zones of relative risk. The alluvial valleys (Zones R and R_L) are considered as having negligible risk; the terrace deposits and Paso Robles Formation (Zones Q and P) as having low risk; Cretaceous rocks (Zone K) as having moderate risk; Tertiary rocks (Zone T) as having high risk; and Franciscan rocks (Zone F) as having very high risk. These zones and known landslides are delineated on the Seismic Zones Map.

Tsunamis and Seiches

Tsunamis, or "tidal waves", are limited to the coastline of the County, and are not a hazard in the City.

True seismic seiches are not considered as constituting a significant hazard in the City.

3. Morro Bay, South Bay, Cayucos and Vicinity

Conclusions regarding seismic and geologic hazards are summarized from the Seismic Safety Element of the City of Morro Bay for that City, and from County Element for the other areas.

Active Faulting

No active or potentially active faults, as defined by the State Geologist and the State Mining and Geology Board, are known to be present in, or in the near vicinity of, this area.

Ground Shaking

The primary source of strong ground shaking in the area is expected to be the San Andreas fault. An earthquake of Richter magnitude 8.0 to 8.5 is expected in the near future.

Shaking from the earthquakes expected on the Nacimiento or the Rinconada and Offshore faults would not

significantly modify the severity of shaking expected from the San Andreas fault except near Cayucos where a slightly higher level of shaking is expected as a result of earthquakes expected from the Nacimiento fault at risk levels applicable to critical facilities.

The area is located in Zone L (Partially in Zone 2 for critical facilities) of the County Seismic Safety Element. The characteristics of expected shaking for microzones, based on variations of rock/soil type, are summarized on Plate I of the Morro Bay Element and on Plate 2A of the County Element. The characteristics of the ground shaking are described in detail on figures and in tables in each of these Elements.

Secondary Hazards

The potential for liquefaction and significant settlement is considered very high on the bay muds (Seismic Zone "X") in and adjacent to Morro Bay; high on landslide deposits (delineated on plates); moderate to high on Recent alluvium (Seismic Zone "e"); low to moderate on terrace deposits and older sand dunes (Seismic Zone "d"); low on active sand dunes (Seismic Zone "x"); and, very low on Franciscan bedrock (Seismic Zone "b"). These zones are delineated in varying detail on Plate 1 of the Morro Bay Element and Plate 2A of the County Element.

The areas of higher risk for liquefaction and settlement are generally unsuitable for development because of other hazards such as flooding, tidal inundation or landsliding.

The appraisal of slope stability is displayed on Plate I of the Morro Bay Element and Plate 2B of the County Element. Two basic categories are present: negligible to low risk (categories 0 and 1) in the lowlands and on the terraces; and high risk (Category 4) on the Franciscan bedrock. Known landslides are delineated where they have been mapped as near Morro Bay, but critical areas near Cayucos and Whale Rock Reservoir have not been mapped.

Further delineation of landslides in this area is necessary to adequately evaluate risks to Cayucos either directly or from flooding due to landsliding into Whale Rock Reservoir.

Tsunamis and Seiches

Tsunamis, or "tidal waves", are potentially dangerous along the beach and in Morro Bay if the tsunami and high tide should occur in phase.

Considerations and response recommended by the State Division of Mines and Geology are included in the Morro Bay Seismic Safety Element.

True seismic seiches are not considered a hazard in this area, but traveling waves generated by possible landsliding into Whale Rock Reservoir, as noted above, may constitute a significant hazard.

4. Paso Robles, Atascadero and Vicinity

Conclusions regarding seismic and geologic hazards in this area are summarized from the Seismic Safety Elements of the City of Paso Robles and the County Element.

Active Faulting

The Rinconada and Jolon faults are considered potentially active by the California Division of Mines and Geology. However, review of available information and field examinations conducted for the Elements noted above indicate that neither of these faults is active with respect to ground rupture.

Ground Shaking

The primary source of strong ground shaking in the

area is expected to be the San Andreas fault. An earthquake of Richter magnitude 8.0 to 8.5 is expected in the near future.

Shaking from earthquakes expected on the Nacimiento, Rinconada and Jolon faults would not significantly modify the severity of shaking expected from the San Andreas fault.

The area is located in Zone 2 of the County Seismic Safety Element. The characteristics of expected shaking for microzones, based on variations in rock/soil type, are summarized in Tables 14 and 15 and Figures 41 through 43 of this Element, and in Tables 1 and 2 of the Paso Robles Element. The zones are delineated on Plate 1A of the County Element and Plate I of the Paso Robles Element.

Secondary Hazards

Areas susceptible to damaging settlement, particularly as a result of earthquake shaking, are limited primarily to those underlain by relatively thick sections of loose, Recent alluvium such as that found in the present channel of the Salinas River where the risks from flooding exceed those from settlement or liquefaction.

Hazards from liquefaction are greatest in the active river channels, but, as noted above, the flood hazard in these areas probably exceeds that from liquefaction. A low to moderate hazard is present in those areas located on terrace deposits or Paso Robles Formation ('d" zones on maps from both elements noted above) where groundwater is shallower than 30 feet. The liquefaction potential is considered very low to non-existent on the firmer and better consolidated rock.

The landslide risk rating is low to negligible in most areas near Paso Robles, but increases to moderately high in the bedded Tertiary rock at Atascadero and along the west edge of Paso Robles. These areas are delineated on Plate IB of the County Element and Plate I of the Paso Robles Element.

Tsunamis and Seiches

Tsunamis, or "tidal waves", are limited to the coastline of the County, and are not a hazard in this area.

True seismic seiches are not considered as constituting a significant hazard in this area.

5. Pismo Beach, Arroyo Grande, Grover City, Oceano, and Vicinity

Conclusions regarding seismic and geologic hazards are summarized from the Seismic Safety Elements of the Cities of Pismo Beach, Arroyo Grande, and Grover City and from the County Element for other areas.

Active Faulting

No active or potentially active faults, as defined by the State Geologist and the State Mining and Geology Board, are known to be present in, or in the near vicinity of the area.

Ground Shaking

The primary source of strong ground shaking in the area is expected to be the San Andreas fault. An earthquake of Richter magnitude 8,0 to 8.5 is expected in the near future.

Shaking from earthquakes expected on the Rinconada and Offshore faults would not significantly modify the severity of shaking expected from the San Andreas fault.

The area is located in Zone 1 of the County Seismic Safety Element. The characteristics of expected shaking for microzones, based on variations in rock/soil type, are summarized in Tables 14 and 15 and in Figures 38 through 40 of the County Element, and in comparable tables and figures in the City Elements. The zones are delineated on Plate 2A of the County Element and on Plate I of the Elements for the Cities noted above.

Secondary Hazards

Liquefaction potential is moderate to high in Recent alluvium ("e" zones), including beach sand, and in landslide deposits where the water table is less than 30 feet from the surface. A low to moderate potential is present under similar groundwater conditions at sites underlain by older sand dunes, terrace deposits and "Paso Robles Formation" ("d" zones). These zones are delineated on Plate 2A of the County Element and in greater detail on Plate I of the City Elements.

Settlement has a comparable level of potential hazard, but does not require a shallow groundwater condition.

Landslide risk is rated high on known landslides and Tertiary sedimentary rocks in steeper terrains; moderately high on Tertiary sedimentary rocks in low to moderate terrain; low to moderate on the terrace deposits and the "Paso Robles Formation"; and negligible on alluvium and older sand dunes. These risk categories are delineated on Plate 2B of the County Element and in greater detail on Plate I of the Elements for Arroyo Grande and Pismo Beach.

Tsunamis and Seiches

Tsunamis, or "tidal waves", are potentially dangerous along the beach areas if the tsunami and high tide should occur in phase.

Considerations and response recommended by the State Division of Mines and Geology are included in the Morro Bay Seismic Safety Element.

True seismic seiches are not considered a hazard in this area.

6. Cambria and Vicinity

Conclusions regarding seismic and geologic hazards are summarized on the basis of data included in the County Seismic Safety Element.

Active Faulting

No active or potentially active faults, as defined by the State Geologist and the State Mining and Geology Board, are known to be present in, or in the near vicinity of, the area.

Ground Shaking

The primary source of strong ground shaking in the area is expected to be the San Andreas fault. An earthquake of Richter magnitude 8.0 to 8.5 is expected in the near future.

Shaking from earthquakes expected on the Nacimiento and Offshore faults would not significantly modify the severity of shaking expected from the San Andreas fault.

The community is located in Zone 1 of the County Seismic Safety Element. The characteristics of expected shaking for microzones, based on variations in rock/soil type, are summarized in Tables 14 and 15 and Figures 38 through 40 of the County Element. The zones are delineated on Plate 2A of the County Element.

Secondary Hazards

The settlement and liquefaction potential is moderate to high on Recent alluvium along creeks in this area ("e" Zones), and low to moderate on Quaternary terrace deposits ("d" Zones). These zones are delineated in Plate 2A of the County Element.

Landslide risk varies from high on Franciscan bedrock, to moderately high on Cretaceous rocks, to low to negligible on the terraces and valley alluvium. These zones are delineated in Plate 2B of the County Element.

Tsunamis and Seiches

Tsunamis, or "tidal waves", are potentially dangerous along the beach areas if the tsunami and high tide should occur in phase.

Considerations and response recommended by the State Division of Mines and Geology are included in the Morro Bay Seismic Safety Element.

True seismic seiches are not considered a hazard in this area.

7. Nipomo and Vicinity

Conclusions regarding seismic and geologic hazards are summarized on the basis of data included in the County Seismic Safety Element.

Active Faulting

No active or potentially active faults, as defined by the State Geologist and the State Mining and Geology Board, are known to be present in, or in the near vicinity of, the area.

Ground Shaking

The primary source of strong ground shaking in the area is expected to be the San Andreas fault. An earthquake of Richter magnitude 8.0 to 8.5 is expected in the near future.

Shaking from earthquakes expected on the Rinconada and Offshore faults would not significantly modify the severity of shaking expected from the San Andreas fault.

The community is located in Zone 1 of the County Seismic Safety Element. The characteristics of expected shaking for microzones, based on variations in rock/soil types, are summarized in Tables 14 and 15 and Figures 38 through 40 of the County Element. The zones are delineated on Plate 2A of the County Element.

Secondary Hazards

The settlement and liquefaction potential is moderate to high on Recent alluvium along creeks in this area ("e" Zones), low to moderate on Quaternary terrace deposits ("d" Zones), and very low to essentially non-existent on bedrock ("c" Zones). These zones are delineated on Plate 2A of the County Element.

Landslide risk varies from moderate to moderately high on bedrock to low or negligible on alluvium. These categories are delineated on Plate 2B of the County Element.

Tsunamis and Seiches

Tsunamis, or "tidal waves", are limited to the coastline of the County, and are not a hazard in this area.

True seismic seiches are not considered as constituting a significant hazard in this area.

C. Effects on Utilities

The effects of strong earthquakes on utility systems have been a major concern in recent years because of the extensive damage to these "lifelines" of the community during the 1971 San Fernando earthquake. A recent summary study by Moran and Duke (1975) of the damage to public utilities as a result of the San Fernando earthquake concludes:

"1. Modern steel water storage tanks and old water-reservoir roof structures performed poorly. Old hydraulic earth-fill dams, not designed to resist earthquake loads, performed poorly, with two experiencing near-failure.

2. Underground conduits for water, sewage, storm-water, gas and petroleum were damaged, mainly because of permanent differential ground-movements rather than due to vibration. Effective preventive measures in this field will be difficult to develop. Potential ground-movement areas should be identified.

3. Large underground structures such as the Finished Water Reservoir at the Joseph Jensen Filtration Plant require special attention. Apparently they act much like structures above grade. More research is needed, along with development of design criteria.

4. Electrical power equipment performed poorly. Failures were due to inadequate anchorage and bracing and in some cases to inadequate aseismic details within the equipment.

5. Communication equipment in the telephone industry performed well except for several failures due to inadequate or poorly detailed and constructed anchorages and bracing."

Any comparison of the damage at San Fernando and expected damage in San Luis Obispo County, however, should be taken in the context that most of the significant damage in the San Fernando area was along or near the zone of fault rupture or in areas of very intense ground shaking with some liquefaction. Comparable areas in San Luis Obispo County would be primarily located in Seismic Zone 4 (Plate 1A of County Seismic Safety Element) near the San Andreas fault.

Some damage may occur in the more populous western zones should liquefaction, differential settlement, or significant landsliding occur beneath a structure or along a buried utility line. Since these effects are normally a consideration in the design of more important structures and buried lines and electrical transmission lines are little affected, future problems in the western zones should be limited to older facilities constructed before soils engineering was an established part of design and construction.

D. Nuclear Reactor Facilities

Geologic and seismic studies to determine the safety of nuclear reactor facilities exceed by several orders of magnitude the depth and detail of similar studies necessary for the Seismic Safety and Safety Elements of a General Plan. For purposes of this Element it is assumed that some finite risk, however small, does exist, and that it is appropriate to plan for a nuclear accident. The planning for such an accident, discussed later in this Element, should in no way be construed to indicate that the technical analysis of this Element has evaluated the risk of such an event, or that this report considers the risk of such and event to be significant.

E. Dam Safety

Geologic and seismic hazards as they affect dam safety have been of concern for several decades, but have become of particular concern since the near-catastrophic failure of Lower San Fernando Dam (Lower Van Norman Reservoir) during the 1971 San Fernando earthquake. This dam was a hydraulic fill structure constructed in the early 1900's, and strengthened in part using modern, compacted fill methods. The failure was in the older hydraulic fill portion of the embankment, and a modern earthfill dam nearby was essentially

undamaged by what must be considered a comparable intensity of shaking. Also, it should be noted that Pacoima Dam, a concrete arch structure located north of Sylmar, was subjected to as great or greater intensities of shaking with relatively little damage. It is for this reason that concern for seismic effects on the safety of dams has concentrated on the older hydraulic fill structures in the State.

Geologic hazards as they affect dam safety are primarily rupture along an active fault through the dam itself; and overtopping of impounded water as a result of massive landsliding into a full or near-full reservoir. The former is not a significant hazard to any of the major dams in the County, based on studies of fault activity for the Seismic Safety Element; and the latter is of potential significance primarily at Whale Rock Reservoir. This Reservoir is flanked by serpentine-bearing Franciscan rocks that are particularly susceptible to landsliding such as that now active near the Cayucos-Morro Bay District Cemetary. This, in conjunction with the proximity of the Reservoir to developed parts of Cayucos, constitutes the most significant dam safety hazard in the County.

Other major dams in the County are of relatively large size in comparison to potential landslide volumes. While some landsliding into these reservoirs may occur, their volumes are probably large enough to accommodate even a relatively large slide with minimal downstream risk and only moderate damage to shore facilities from traveling waves. Whale Rock, however, is relatively small in comparison to potential slide volumes, and further study of this potential hazard is recommended.

V. RADIATION HAZARDS

A. Purpose and Scope of Evaluation

The focus of this section of the Safety Element is on the possibility of radiation hazards arising from the presence of nuclear reactors in San Luis Obispo County. Unlike the analyses of fire, flooding, and geologic hazards, this evaluation does not in any way attempt to determine risk criteria or assign levels of acceptable risk. Such determinations would require prolonged studies which are clearly beyond the scope of the Safety Element. In contrast to a risk analysis, the report assumes that some level of risk exists, however small, and that there is the possibility of harmful levels of radiation being released. In making this assumption, the emphasis of the analysis shifts from a description of the hazard to a description of what should be done to respond to it. This is primarily a concern of emergency preparedness policy, which is addressed in Section VI and in Volume One, the Policy Report.

The purpose of this part of the report is to provide a brief, general discussion of radiation hazards, and to define some of the terms used in such discussions. This is intended to provide a background for the policy recommendations in Volume One regarding radiation hazards.

B. Radiation

Radiation is defined as the release of energy from naturally occurring elements in the form of particles or waves. Radiation has always been a part of nature, and we are subject to certain levels of radiation every day. However man has achieved the ability to both concentrate and disperse radiation at levels which do not occur in nature, and which can be harmful to almost all forms of life. To understand the hazardous aspects of radiation, it is necessary to discuss its basic nature.

Radioactivity is a state in which certain elements of matter spontaneously disintegrate and change into different, more stable elements. In the process of disintegrating, the elements give off the subatomic particles and wave energy which comprise the three main kinds of radiation: alpha, beta, and gamma radiation. Both alpha and beta radiation are particles of electromagnetic radiation. Alpha particles are relatively large in size, and have only a weak ability to penetrate very far through the air or any other substance. On the other hand, beta particles are high speed electrons which have a significantly greater penetrating power. Most biological damage from alpha and beta radiation is limited to the skin, unless taken internally, in which case these types of radiation can be extremely hazardous.

Gamma rays, which are related to X-rays, are a form of wave energy. Gamma radiation penetrates organic matter readily and can do great damage to virtually all of the body's organs. A lead or some other heavy metal shield is necessary to screen against gamma radiation.

Different measures of radiation have been developed, and most are based either on the rate of disintegrations taking place in an element or on the dosage of radiation received by an organism. The base measure of disintegrations is the curie, which is defined as 3.7×10^{10} disintegrations per second, and is about equal to the radioactivity of one gram of the element radium and its decay products. Since 37 billion disintegrations is too large a number for practical purposes, smaller measures based on the curie are the millicurie (one-thousandth of a curie), the microcurie (one-millionth of a curie), and the picocurie (10^{-12} of a curie). These measures are not dosages, however. The roentgen (abbreviated r) is a dosage measure of the number of ionizations caused by radiation in air. It is defined as the amount of

radiation causing 1.6×10^{12} ionizations in one cubic centimeter of air. (An ionization occurs when a neutral atom loses an electron to become negatively charged.) Since the concern of dose rates is with living tissues, rather than air, the rem and rad measures were developed. The rad is defined as 100 ergs (a unit of energy) absorbed by one gram of tissue. The rem (for roentgen equivalent man) is a very similar measure which takes into account the relative biological effects of radiation. For the purposes of the following discussion of the effects of radiation, the rad and rem will be considered as the approximate equivalent of a roentgen.

C. Effects of Radiation

Radiation affects living organisms by injuring or killing cells. Just as radiation causes ionization of air molecules, it also causes ionization of the molecules which make up the cells of living tissue. This results in the deterioration and death of the cells.

It has been determined from accidents which resulted in radiation exposure that a dose of 100 r is fatal to all humans. It is estimated that the lethal dose for 50 percent of a given population (termed the LD-50) is about 500 r. Radiation sickness develops at levels of 100 to 300 r, and is symptomized first by nausea, vomiting, diarrhea, and various nervous disorders. These symptoms are followed by a period of relative well-being and then by secondary symptoms, including a decrease in red and white blood cells, hemorrhaging just under the skin, loss of hair, and ulcers of the mouth and stomach. These symptoms also diminish and a slow recovery begins. The cells most sensitive to radiation are those which have the highest reproductive rates under normal conditions. These include the blood-forming tissues, bone marrow, lymph nodes, spleen, reproductive organs, and intestinal lining. The eye lens is also quite sensitive to radiation and can develop a cataract or opacity. Between 25 and 100 r no visible symptoms occur, but the number of white blood cells decreases. Below 25 r, no measureable changes have been observed.

Most of us are exposed to about 0.1 r over a year's time from naturally occurring sources. These sources include cosmic rays from outer space, radioactive elements within our own bodies, and radioactive elements in the rocks and soil around us. At higher altitudes, about 50 percent more radiation is picked up by people because of greater exposure to cosmic rays. X-ray examinations are another common source of radiation exposure. Whether these low levels of exposure are harmful is open to some question. While there are no immediate symptoms to low levels of radiation, there is the possibility that long-term exposure to low levels of radiation may have the same effect as an equivalent single high dose. That is, it may make little difference whether a person is exposed to 1 r per year for years or 10 r in a single year. There is little evidence at this time to provide any sure answers to this question.

D. Nuclear Power Plants

The potential for radiation hazards due to the presence of nuclear reactors in the County arises from the use of highly radioactive elements as the fuel for heat within the power plant. Reactors, such as those under construction at Diablo Canyon, typically use a mixture of two isotopes of uranium as fuel. The uranium is packed as pellets into stainless steel or zirconium alloy rods and grouped in subassemblies. Water is passed through these rod assemblies which causes it to boil. The resulting steam is bled off and turns a turbine generating power.

The possibility of radiation hazards at power plants are well recognized, and deterrents to potential accidents are incorporated into the design, construction, and operational procedures of nuclear power plants. Automatic safety devices are built into power plants to counteract the failure of any part of the reactor system. Those measures have reduced the probability of an accidental release of radiation to very low levels. However, even though accidents at plants are most unlikely, it is prudent to assume that an accident is possible and to plan for emergency responses.

The State of California Nuclear Power Plant Emergency Response Plan assumes that accidents of different orders of magnitude may occur in the delivery, use, disposal, and storage of radioactive fuel. These accidents are postulated to result in the release of radioactive material into the air or water. The categories of accidents are summarized below:

1. Atmospheric dispersion

Classes A through D involve release of airborne radioactive material from a plant. The escalation from one class to the next will initiate or increase the involvement of different support groups and the implementation of additional protective actions.

a. Class A. Confined to a single plant structure. Release of radioactive materials does not exceed accepted safety limits. Therefore, no measures are required to protect persons in areas outside of the affected structure.

b. Class B. Release of radioactive material from plant structures which may require that protective actions be taken to prevent exposure and contamination of on-site personnel who are not required for recovery actions. It is not expected that a class B release would produce dose rates or iodine levels sufficient to initiate protective measures off-site.

c. Class C. Release of radioactive material will almost certainly require that on-site personnel not actively engaged in recovery actions be evacuated to radiation safe off-site locations. In addition, off-site releases will exceed permissible levels of radiation in uncontrolled areas.* Some off-site emergency actions are required (see III Radiation Countermeasures).

At the low end of the range, only minor measures such as controlling access to the affected areas and instructing people in the area to remain indoors will be required. At the higher end of the range, some off-site personnel may be evacuated.

d. Class D. Release of radioactive material requires immediate evacuation of on-site personnel not actively engaged in recovery action and evacuation of the populated zone far enough downwind from the plant sufficient to clear an area in which permissible levels of radiation for an uncontrollable area are expected to be exceeded.

2. Water dispersion

Accidental release of liquid radioactive material is either a Class E or F.

a. Class E (on-site)

Liquid releases confined and controlled on-site. They do not pose a threat to persons outside the immediate area unless the liquid release also results in releases of airborne radioactive material.

b. Class F (off-site)

Liquid releases off-site which are in excess of permissible amounts could pose a threat to the health and safety of

*Title 17, California Administrative Code, Section 30268 and 30269.

the general population, livestock and wild life. Primarily, the threat would occur only if the outfall discharges directly into a river or watercourse used as a drinking water source or for recreational purposes. Discharges of hazardous quantities of radioactive materials into such a stream would create an immediate problem. A discharge into the ocean would not create such an immediate problem. Long term exposure pathways might include contamination of fish and shellfish used as a source of food for human consumption. Genetic effects to oceanic life from exposure to contaminated sediment and immersion in the contaminated water could also occur.

These potential nuclear accidents form the basis of emergency response planning in the state plan. At this time, San Luis Obispo County is in the process of preparing its own Nuclear Power Plan Emergency Response Plan in accordance with State guidelines.

E. Nuclear Fuel Transport

In addition to planning for potential accidents at the nuclear power plant itself, it is prudent to plan for an accident during the transport of the radioactive fuel for the plant. Safety concerns arising from nuclear fuel transport center on the transportation of irradiated "spent" fuel removed from the power plant's reactor. Transportation of "fresh" fuel from the fabrication plant poses minimal problems compared to "spent" fuel because it has not been irradiated, and therefore, does not constitute a radiation hazard to anyone near the vehicle.

As with the power plant itself, the primary deterrent to potential accidents during the transportation of spent fuel is the design and construction of the containment vessels called casks used in shipping. The two primary agencies governing transportation of irradiated fuel are the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Transportation (DOT). The NRC regulates possession of radioactive materials, transportation procedures, and shipping cask criteria. DOT regulations cover additional procedural and packaging requirements. The basic criterion for design of shipping casks is that there be no loss of containment of radioactive materials following a specified "design basis accident." NRC regulations specify that the design accident is assumed to occur in the following sequence:

(1) a 30-foot free drop onto a flat unyielding surface with the cask oriented such that maximum damage will occur,

(2) a 40-inch free drop onto the top end of a six-inch diameter, eight-inch high mild steel bar with the cask oriented such that maximum damage will occur,

(3) exposure to a 1475^{o}F fire for a 30-minute period with no artificial post-fire cooling,

(4) immersion of the entire cask in water to a depth of three feet for at least eight hours.

These criteria represent an accident which may be described as something like the following: a shipping cask on train passing over a freeway is thrown off the train when the train is derailed. The cask lands 30 feet below on the freeway, and is hit by a tank truck carrying jet aviation fuel which explodes into flames. The cask is enveloped in flames for 30 minutes. Then it rolls off the road into a lake and is submerged for eight hours before being recovered. NRC regulations require that the cask survive this magniutde of accident with no loss of containment.

There are presently three methods of transporting loaded casks: truck, rail, and barge. The use of barges has practically been eliminated because they are more costly and less convenient than truck or rail transport. Trucks are widely used now, but with the advent of larger,

heavier casks there will probably be a decrease in the use of trucks because of highway weight restrictions. This leaves rail transport as the primary mode for shipping irradiated fule.

In San Luis Obispo County, there is only one rail line, the Southern Pacific line, and it does not serve the Diablo Canyon area directly. The proposed transportation procedures for removing irradiated fuel, then, involve a combination of rail and truck transport. This method involves a special-permit overweight truck movement from the reactor to the nearest railhead, which is in the City of Pismo Beach. The railhead transfer is a drive-on, drive-off procedure similar to the "piggyback" loading method now used in transporting other commodities.

At this time, trucks carrying irradiated fuel have not been given permission to use U.S. Route 101 because of weight and speed restrictions. The most likely truck route from the power plant will be along the P G & E access road to Avila Road, along Avila Road to Palisades Road, Palisades Road to Shell Beach Road, Shell Beach Road to Highway 1 and Highway 1 to the railhead. There is some question as to whether these roads will be able to carry the weight of loaded trucks, and it may be necessary to upgrade the existing road surfaces. One alternative that has been suggested would be for P G & E to construct a new road designed to carry the trucks. A new road could be constructed to avoid transporting the irradiated fuel through Pismo Beach. One suggested route is through Crag Canyon and through the canyon east of the hills bordering Pismo Beach. Another alternative would be the construction of a rail line from the existing Southern Pacific line to the community of Avila near the P G & E access road to Diablo Canyon.

Whatever transportation mode is used, NRC regulations require strict monitoring of the movement of radioactive material. One area of concern regarding fuel shipments is the possibility of sabotage of spent fuel casks or theft of fresh fuel for use in atomic weapons. Shipments of quantities of nuclear fuel which are significant from a weapons standpoint require two drivers for each truck escorted by a separate vehicle carrying armed guards. In cases where shipments are unescorted, the truck is equipped with special protective features and direct radio communication between the vehicle and a relay station. In the event of a diversion attempt, the objective of the security system is to protect the crew, secure the cargo, and enable the crew to call for reinforcements. It is likely that local law enforcement agencies would be called on to assist in such an event, or in the event of an accident involving spent fuel.

VI. EMERGENCY PREPAREDNESS

A. General Statement

One of the central purposes of the Safety Element is to provide an analysis of the risk posed by several different types of hazards. An integral part of risk evaluations is an analysis of the ability of people to respond to expected hazards. In large measure, how well a community perceives a potential hazard and how well it is prepared to react determines the overall impact of a hazardous event. This is illustrated by the differing responses to two major tsunamis which hit Hilo, Hawaii, as a result of earthquakes in Chile (1960) and Alaska (1964). In 1960, Hilo experienced a tsunami in which 61 people were killed and 283 injured. Some of the contributing factors to this disaster were the failure by some to heed warning signals, the inexplicable refusal by others to leave hazardous areas, and the mistaken belief by others that they were in safe areas. As a result of the disaster, a carefully prepared emergency response plan was prepared which delineated clear lines of responsibility and provided for necessary communication systems. In 1964, when the tsunami alert was issued, Hilo residents were quickly evacuated, and no deaths resulted.

There are many factors to consider in evaluating emergency preparedness, but perhaps the most important are (1) emergency response organization, (2) communication system, and (3) the medical care system. The following sections provide a summary of the status of each of these factors in San Luis Obispo County and in the Cities within the County.

B. Emergency Response Organization

Natural disasters and man-made emergencies are situations in which cooperation and efficient functioning of agencies at all governmental levels is perhaps most vital. Coordination of a complex organization of local, state, and federal agencies determines the ability of people to respond to a disaster, which, in turn, helps determine the toll wrought by the disaster. This section traces the interagency relationships that define the peacetime emergency response organization within San Luis Obispo County.

All local governments within California are required by the California Emergency Services Act (Chapter 7 of Division 1 of Title 2 of the Government Code) to prepare an Emergency Plan in conjunction with the State of California Emergency Plan. The purpose of the local Emergency Plans is to establish the organization which will plan and conduct services during peace or wartime emergencies. The objectives of the organization are to:

1. Save lives and protect property.
2. Repair and restore essential systems and services.
3. Provide a basis for direction and control of emergency operations.
4. Provide for the protection, use and distribution of remaining resources.
5. Provide for the continuity of government.
6. Coordinate operations with the emergency service organizations of other jurisdictions.

These objectives are to be met through specified channels of authority and mutual aid, when necessary. The concept of mutual aid is particularly important when dealing with emergencies such as wildland fire, flooding, and geologic hazards. These hazards have potential for occurring over a large area at one time, thereby exhausting the resources of the local agencies in the area. Adequate response then requires that other agencies be brought in to assist the

local agencies. San Luis Obispo County is the northernmost county within State Mutual Aid Region I, which includes Santa Barbara, Ventura, Los Angeles and Orange Counties. The County itself forms the next level of organization as an Operational Area, and the Cities in the County form the first level of organization (Figure 1).

Although the mutual aid system extends upward to the federal and state levels, primary control of the emergency situation remains in local hands, either with the City or County. The emergency relationships between the Cities and County are therefore the most critical links in the system. Figure 2 shows the interjurisdictional emergency relations for San Luis Obispo County. The request channels illustrated are based on the use of local resources before calling for aid from other jurisdictions. It is not necessary, however, that every single person and piece of equipment be committed to an emergency before mutual aid agreements become active. In some large-scale disasters, regional resources are utilized even prior to a request for assistance. For smaller scale emergencies that may affect only one or two cities, the normal procedure is for the City to use up its resources and then request aid from the San Luis Obispo County Sheriff. The Sheriff acts as the Operational Area coordinator and employs his personnel and equipment to meet the situation. Should these not prove sufficient, he requests support from other Cities in the County and then from the Regional Mutual Aid Coordinator.

One of the potential problems with mutual aid agreements is that each jurisdiction, in relying on other jurisdictions for help in a major disaster, may fail to provide adequately for its own self-sufficiency. Both the Seismic Safety and Safety Elements are intended to help mitigate this potential problem by providing some estimate of the magnitude of emergencies which can be expected in an area. These estimates indicate that large scale emergencies,

Figure 1.
Mutual Aid System

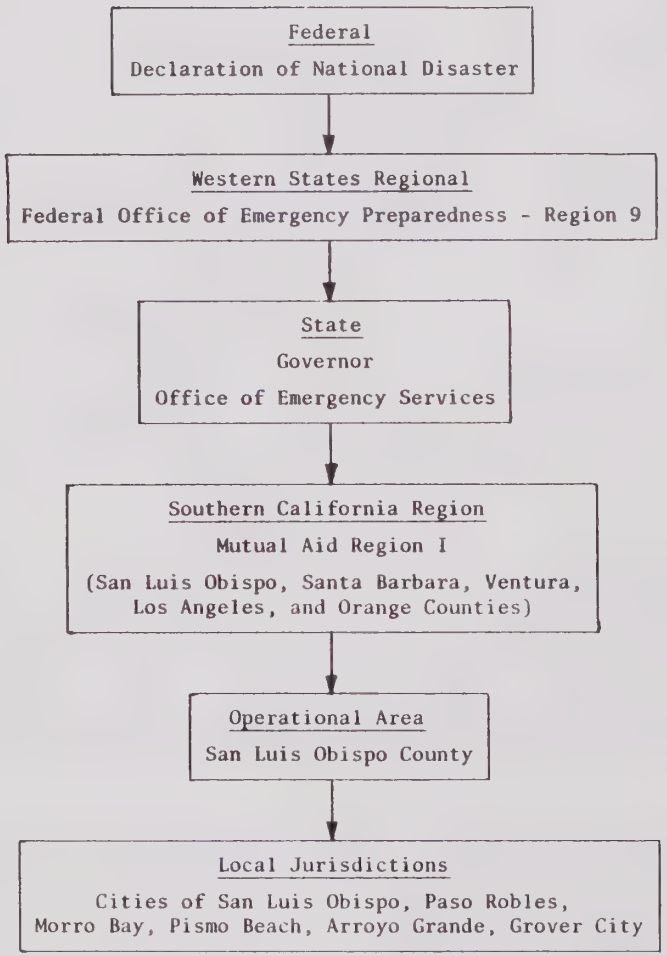
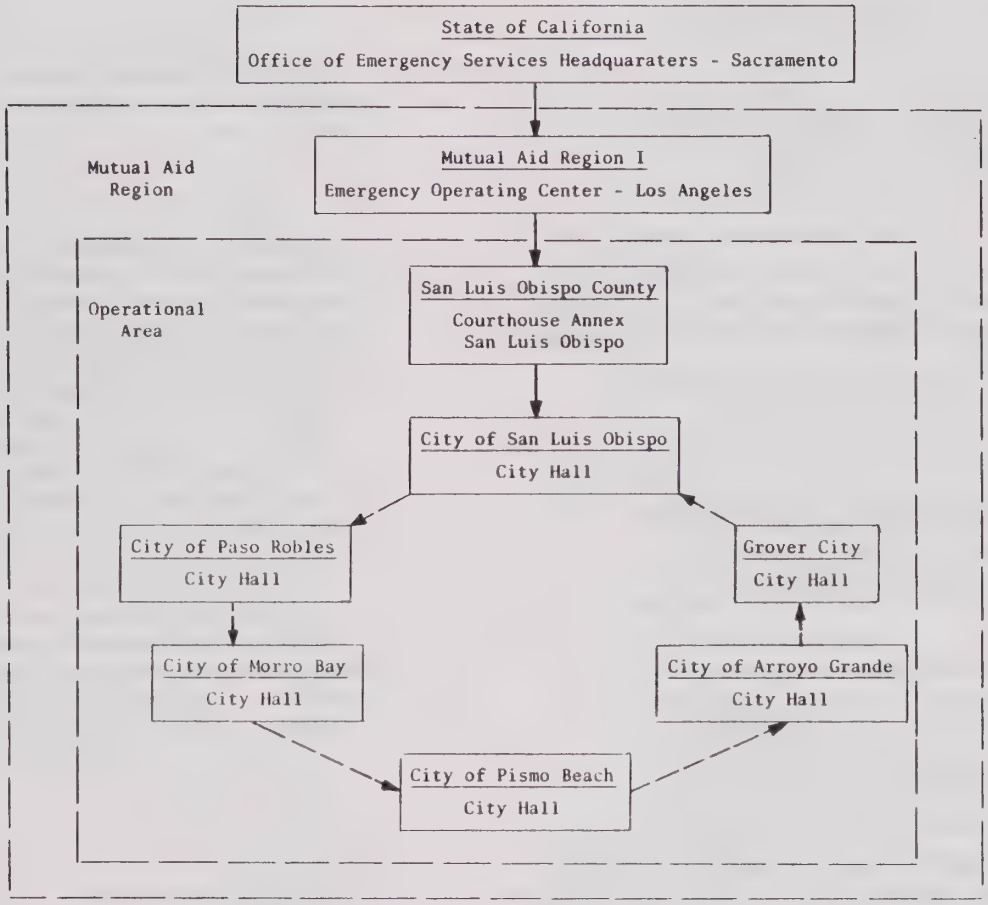


Figure 2.

Interjurisdictional Emergency Relationships



primarily a major earthquake, can be expected in San Luis Obispo County and Southern California as a whole, which may strain mutual aid capabilities to their limit. It is advisable that each jurisdiction in San Luis Obispo County be prepared to rely on its own resources for at least a short period of time.

C. Communications

1. Inventories

The communications system which links individual emergency agencies is of critical importance to successful response to a disaster. This section traces the individual channels of emergency communication within San Luis Obispo County and links between County, state and federal agencies.

a. Federal

The principal emergency warning system at the national level is the National Attack Warning System (NAWAS), which was developed primarily to warn people and provide emergency information during wartime emergencies. Portions of the system are used, however, for peacetime emergencies, augmented by state and local systems as appropriate. The system is a dedicated wire-line system which provides two-way voice communication between Federal Warning Centers (i.e., Washington D.C., Colorado Springs), states' Warning Points (Sacramento), and substate Warning Points (Santa Barbara).

The NAWAS system is also connected to the State's Bell and Lights warning system. This system is a wire-line system which activates an instrument to display a series of color-coded lights corresponding to a signal transmitted from the substate Warning Point.

b. State

Emergency communications within California utilize either the California Communications System or one (or several) of a variety of other communication networks in the state which are linked to local government facilities. The California Communications System includes the following:

(a) Very High Frequency radio voice networks which:

(1) provide line-of-sight coverage;

(2) use mountain-top repeaters for extended coverage; and

(3) intertie to microwave relays to provide statewide coverage.

(b) Telephone circuits:

(1) commercial, public, and private-line; and

(2) microwave (State Integrated System).

(c) Teletype circuits:

(1) wire; and

(2) radio.

Other communications systems which may be used in major emergencies, but which normally are used for other purposes, include these:

(a) Radio

(1) Intercity Law Network

Serves all OES facilities and interconnects law enforcement agencies of 51 counties and 87 cities. This system is microwave-intertied, to provide statewide coverage. The Intercity Law Net system is the State's radio backup to the NAWAS system.

(2) Local Government (LG) Radio System

Serves all OES facilities, a number of state agencies, and county-level civil defense agencies participating in the system. The LG system is microwave-interconnected for statewide coverage.

(3) OES Fire Network

Serves all OES facilities and fire support equipment. Radio equipment on this network is located with fire service agencies in 52 counties. The network employs mountain-top mobile relays and interconnects to the State Microwave System to provide statewide coverage. Four vehicular mobile relays are available to provide coverage in any area not covered by permanent mountain-top relays.

(4) Radio Amateur Civil Emergency Services (RACES)

Serves all OES facilities and most local jurisdictions. RACES operates on radio amateur frequencies by authority of the Federal Communications Commission (FCC) in support of emergency communications. RACES can augment existing systems, substitute for damaged or inoperable systems, and establish communications links with otherwise inaccessible areas.

(5) Other State Agency Radio Systems

State agencies with available systems include:

Agency	Coverage
Fish and Game, Department of	Regional
Forestry, Division of	Statewide
Highways, Division of	Regional
Highway Patrol, Department of	Regional
Justice, Department of	Statewide
Water Resources, Department of	Regional

(6) National Communications System II (NACOM II)

A high-frequency single-sideband radio system which provides radio backup to NACOM I described under (c)(2) below.

(b) Telephone

(1) Commercial and Dedicated Landline (Wire) System

(a) Common Carrier telephone service is provided in sufficient quantity to support all emergency systems.

(b) National Warning System (NAWAS) is described in Attachment C, Warning System, paragraph B, "War Emergency Warning System."

(c) Utilities Hotline is a private line from OES headquarters to two utility companies which subsequently disseminate information to all utilities in the state.

(d) Telephone Company Emergency is a "hotline" to the Pacific Telephone Company emergency center in San Francisco, for fanout to telephone companies.

(2) Microwave

Microwave telephones access those state agencies having a microwave telephone capability. These include:

(a) Office of Emergency Services,

(b) Highway Patrol,

(c) Division of Forestry, and

(d) Division of Highways.

(c) Teletype

(1) California Law Enforcement Telecommunications System (CLETS)

Has 900 terminals in California and serves all 58 counties.

(2) National Communications System I (NACOM I)

A Federal Government teletype system using leased landline facilities of the telephone companies for transmitting information to the federal Office of Civil Defense and Office of Emergency Preparedness and to other states. Furnished and installed at OES headquarters by OCD.

(3) OES Regional Teletype System

Terminals are available at OES headquarters and each OES regional facility. System is used to coordinate interregional mutual aid operations.

(4) Division of Highways Teletype

A receiver located at OES headquarters receives road, weather, and river information for further distribution by OES.

(5) Commercial Dial Teletype

Information can be transmitted to and received from other subscribers nationwide.

c. Local

The primary emergency communications system in the County is that of the Sheriff's Department, since the Sheriff acts as the Operational Area Coordinator. The Sheriff's communications equipment consists of the following:

(a) One base station KMG 280, 39.18 mc.
(b) Thirty-five mobile units, 39.18 mc.
(c) Four portable base stations, 39.18 mc.
(d) Three handi-talkies, 39.18 mc.
(e) Seven handi-talikes, 154.? mc.
(f) One base station KNF 84, 195.03 mc., operating in the state-wide all points system.
(g) Teletype hookup with all police agencies in the county, and state-wide teletype cababilities through CLETS.

In addition to the Sheriff's radio, the following communications systems are available for utilization in an emergency:

(a) County fire radio (base station and mobiles);
(b) Local government radio (base station and mobiles - e.g., County Engineer);
(c) RACES radio (base station and mobiles with multiple modes of operation, including radio teletypewriter);
(d) Department of Justice (CLETS) teletypewriter;
(e) California Highway Patrol radio (monitor only); and
(f) Commercial telephone.

Should these systems not be able to handle communications needs adequately, radio systems used by industry, general contracting, trucking, taxi, railroad, and aviation can be used.

Among the cities in the County, communications inventories are quite similar and normally consist of the police radio, the fire department radio, local government department radios (e.g., City Engineer), amateur radios (e.g., RACES, REACT), and commercial telephone. The Cities in San Luis Obispo County have sufficient inventories of communications equipment, but the kind of equipment may not be suited to large scale coordination among the cities in the

event of a major disaster. In most cases, interdepartmental communication (or at least monitoring) is possible in individual cities. Communication between departments of different cities, however, is not possible. This can prove to be critical in major emergencies. As an illustration, in the recent Big Tujunga fire in Los Angeles County, mutual aid agreements were activated which involved numerous cities and several counties. It was not uncommon for response units from as many as five or six cities to be working together in the same canyon. In one canyon, units from the cities of Glendale, South Pasadena, Pasadena, Alhambra, and Covina had set up a line of defense, but it was not possible for these units to communicate by radio with one another. As a result, it was necessary to communicate by runner, and this severely hampered the total response effort. It was not unusual for a truck to have its water supply cut off without prior warning.

2. Actions

As examples of the way in which the communications networks would work, the following illustrations of major emergencies are provided.

a. Flood

Major floods are usually preceded by a buildup period during which resources and personnel can be marshalled to respond to the emergency. During this period, the State Office of Emergency Services gathers data from the Weather Bureau and the Water Resources Department and relays this information to the affected operational areas. The OES receives this information by teletype service and the Division of Highways teletype system, and relays it by the OES private teletype and to local governments by the CLETS system. Local governments then use their own systems to facilitate evacuation and rescue should that be necessary.

b. Fire

Initial warnings of a major fire usually come from the affected area itself and are issued through the Area or Regional Fire Coordinator. These warnings can utilize any of several communication channels that are available and appropriate. Requests for mutual aid can also use several channels of communication and are made through the Area or Regional Fire Coordinator.

c. Earthquake

Since earthquakes occur without warning (under existing scientific capability), communications are limited to response. Notification of an earthquake, damage reports, and requests for aid can come from several sources, including seismological observatories, OES regional offices, local governments, federal and state agencies, and the Honolulu Observatory. This information may be received via NAWAS, radio, teletype, telephone, and any other available means.

d. Tsunami

Tsunamis, or seismic sea waves generated by earthquakes, usually travel at tremendous rates of speed, often near 400 miles per hour. An earthquake occurring closely offshore would leave little opportunity for warning. Tsunamis generated farther out in the Pacific Basin, however, do allow enough time for warning. Reports of major earthquakes are transmitted to the Honolulu Observatory for evaluation. The Observatory transmits the appropriate information via Federal Aviation Administration circuits to San Francisco, where it is fed into the NAWAS system, and then to coastal counties Warning Points. This same information is also transmitted to local jurisdictions by appropriate radio systems, teletype, and telephone circuites to ensure maximum dissemination.

D. Medical Care

One of the most urgent functions of the emergency preparedness organization is the provision of adequate medical care to those injured in a major disaster. The ability to care for a large number of injured persons quickly is a major factor contributing to the reduction in loss of life caused by disasters. The County's Emergency Plan recognizes this, and calls for medical care facilities to be prepared for a sudden increase in patients of about 50% of their normal patient population.

The California Emergency Medical Mutual Aid Plan also provides guidelines to the County regarding major disasters and medical response. The highest level medical emergency envisioned by the Plan is termed a Level III emergency and is described as follows:

Medical resources in or near the impact area are overwhelmed due to either sheer numbers of casualties and/or damage to the medical resources. Deficiencies in material and/or personnel are such as to require extensive medical mutual aid from outside the county. In this event, the following can be anticipated to apply:

a. A "State of Emergency" may be proclaimed by the Governor;

b. Field treatment may be accomplished, in many cases, by paramedical and/or non-medical personnel;

c. Ambulance services will be inadequate to cope with the numbers of casualties and other transportation resources will be required;

d. Regular ambulances may be reserved for transfer of casualties between medical facilities for specialized treatment rather than for scene-to-facility transportation;

e. Surviving medical staffs whose normal facilities are damaged and inoperable should turn their attention to field treatment (triage, etc.);

f. Peripheral medical facilities should concentrate on receiving immediate treatment cases from the impact area, rather than providing support into the impact area; and

g. The "Leap Frog" concept (see Figure 3) may be utilized to transport:

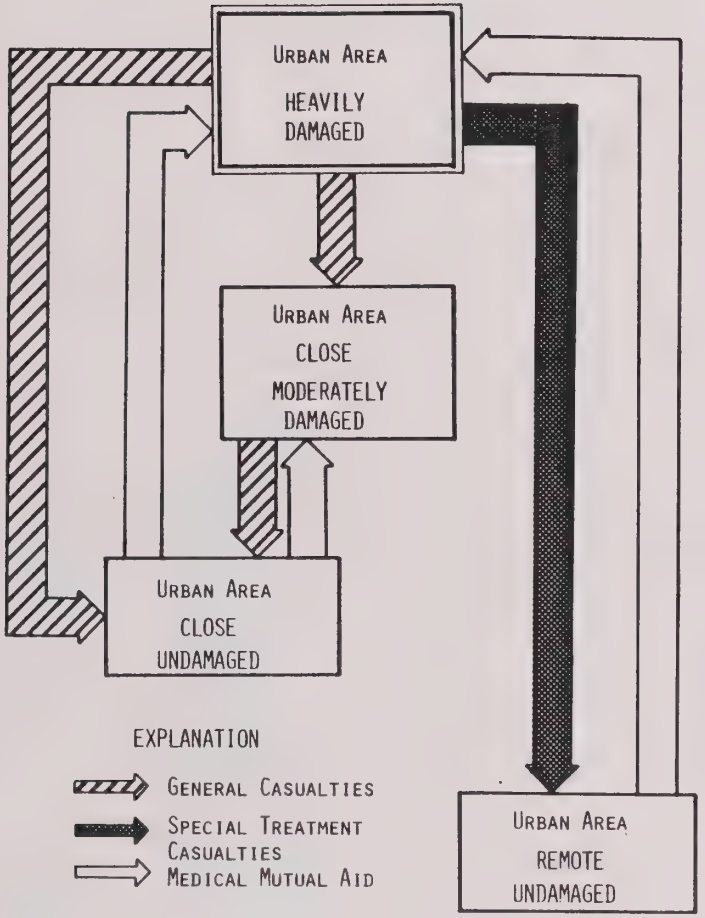
(1) Stabilized casualties to outlying medical facilities;

(2) Special treatment casualties (e.g., burn cases) to specialized medical facilities which may be some distance from the impact area; and

(3) Emergency medical personnel, equipment and supplies from outlying facilities to the impact area; and

h. Peripheral County Emergency Medical Coordinators and the OES Regional Emergency Medical Coordinator will find it necessary to concentrate on coordinating the additional tasks of bringing medical personnel from considerable distance to support field operations and moving casualties considerable distances to outlying medical facilities.

This magnitude emergency is conceivable in San Luis Obispo County given a major earthquake or flood. One of the most important concepts of the Plan is the Leap Frog concept. This concept involves evacuation and transport of (1) stabilized casualties to outlying medical facilities, (2) specialized treatment casualties (e.g., burn cases) to special medical facilities which may be some distance from the impact area, and (3) emergency medical personnel, equipment and supplies from outlying facilities to the impact area. The purpose of these actions is to see that surviving medical facilities will not be overloaded with



LEAP FROG CONCEPT

Figure 3.

casualties or given cases they are not equipped to treat.

Lesser levels of medical emergencies are possible, of course, and the emergency medical facilities in San Luis Obispo County should be able to respond adequately to localized multiple casualty emergencies. The emergency facilities in the County are shown in Table 12 (including Santa Maria Hospital for south County casualties). One of the critical factors determining the success of the medical response to an emergency is the ability to efficiently evacuate the injured persons. Evacuation is also important to preventing injury, as the 1964 tsunami in Hilo, Hawaii, demonstrated.

Emergency evacuation of the injured is accomplished either by ambulance or airlift. All of the hospitals in the County are served by ambulances, and air rescue services are provided to the northern part of the County by the MAST (Military Assistance to Traffic Safety) organization stationed at Fort Ord, and to the southern part of the County by the Air Search and Rescue Team at Vandenberg Air Force Base. Evacuation of non-injured persons is not addressed in the County Emergency Plan or in any of the City's Emergency Plans. This type of evacuation is dependent on several factors, primarily (1) the type of hazard, (2) the severity and location of a hazardous occurrence, and (3) the mode of evacuation. Generalized evacuation routes within the urban areas are shown on the Natural Hazards Map for each jurisdiction. It should be remembered that these routes are only general recommendations. Decisions regarding evacuation are best made when more is known about the nature of the hazardous occurrence. For example, evacuation of a canyon from fire hazard should proceed on the canyon bottom, directly away from the fire. Evacuation of the canyon from flooding or dam inundation should proceed perpendicular to the oncoming water up the sides of the canyon. The Natural Hazards map also shows the relationship between evacuation routes and temporary shelters (e.g., schools, fallout shelters).

Table 12.

SAN LUIS OBISPO COUNTY

EMERGENCY MEDICAL FACILITIES

FACILITY	ADDRESS	OWNED	BEDS	24 Hr. Emergency Service
San Luis Obispo County Hospital	2180 Johnson Ave. San Luis Obispo	Governmental	133	Yes
French Hospital	1911 Johnson Ave. San Luis Obispo	Private	100	Yes
Sierra Vista Hospital	1010 Murray San Luis Obispo	Private	172	Yes
Atascadero General Hospital	5575 Capistrano Ave. Atascadero	Governmental	27	Yes
Paso Robles District Hospital	15th & Terrace Hill Paso Robles	Governmental	32	On Call
Arroyo Grande Community Hospital	345 Halcyon Road Arroyo Grande	Private	48	Yes
Huntington Medical Clinic	Highway #1 & South Bay Blvd. Morro Bay	Private	10	Yes
Santa Maria Hospital	Park View Ave. Santa Maria	Private	Unk	Yes

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